UNIV. OF
TORONTO
LIBRARY

SHOUT
SHARE
IT

A

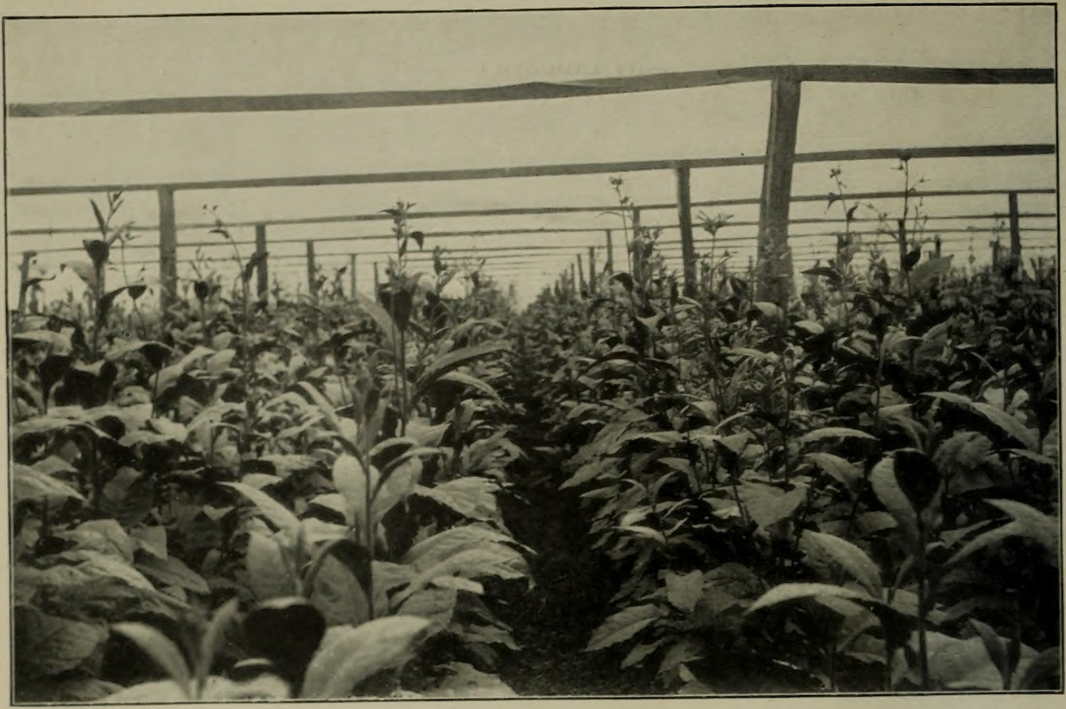


FIG. 1.—CONNECTICUT CUBAN TOBACCO, FIRST YEAR FROM CUBA.

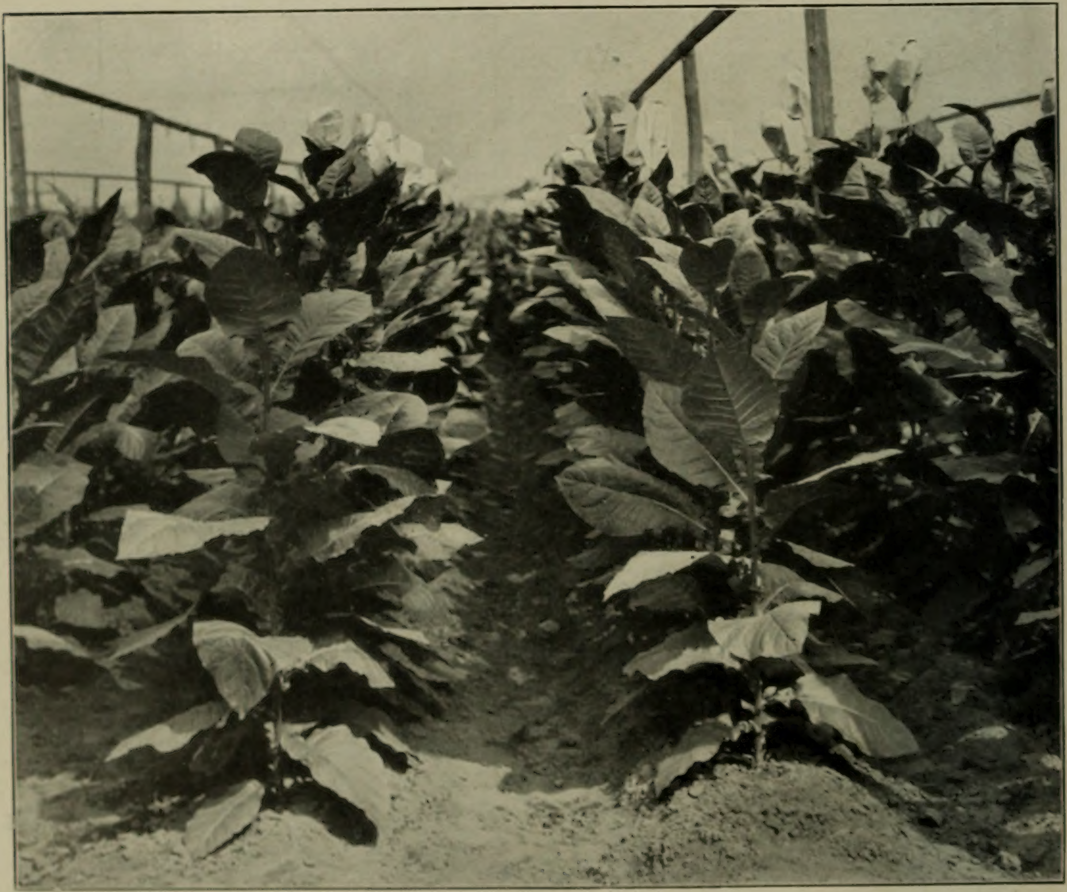


FIG. 2.—THE SAME FIELD SHOWN IN FIGURE 1, AFTER SAVING SEED UNDER BAG AND THE SELECTION OF THE BEST PLANTS FOR TWO YEARS.

Gov't Doc

U.S. Bureau of Plant
Industry, Soils, and
Agricultural Engineering

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 91.—100

B. T. GALLOWAY, *Chief of Bureau.*

VARIETIES OF TOBACCO SEED DISTRIBUTED IN 1905-6, WITH CULTURAL DIRECTIONS.

BY

A. D. SHAMEL AND W. W. COBEY,

IN CHARGE OF TOBACCO BREEDING EXPERIMENTS, LABORATORY OF PLANT BREEDING.

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

ISSUED FEBRUARY 21, 1906.— Oct. 1906

239405
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

SB
19
A35
no. 91-100

BUREAU OF PLANT INDUSTRY.

B. T. GALLOWAY,
Pathologist and Physiologist, and Chief of Bureau.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

ALBERT F. WOODS, *Pathologist and Physiologist in Charge, Acting Chief of Bureau in Absence of Chief.*

BOTANICAL INVESTIGATIONS.

FREDERICK V. COVILLE, *Botanist in Charge.*

FARM MANAGEMENT.

W. J. SPILLMAN, *Agriculturist in Charge.*

POMOLOGICAL INVESTIGATIONS.

G. B. BRACKETT, *Pomologist in Charge.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

A. J. PIETERS, *Botanist in Charge.*

ARLINGTON EXPERIMENTAL FARM.

L. C. CORBETT, *Horticulturist in Charge.*

INVESTIGATIONS IN THE AGRICULTURAL ECONOMY OF TROPICAL AND SUBTROPICAL PLANTS.

O. F. COOK, *Bionomist in Charge.*

DRUG AND POISONOUS PLANT INVESTIGATIONS, AND TEA CULTURE INVESTIGATIONS.

RODNEY H. TRUE, *Physiologist in Charge.*

DRY LAND AGRICULTURE AND WESTERN AGRICULTURAL EXTENSION.

CARL S. SCOFIELD, *Agriculturist in Charge.*

EXPERIMENTAL GARDENS AND GROUNDS.

E. M. BYRNES, *Superintendent.*

SEED LABORATORY.

EDGAR BROWN, *Botanist in Charge.*

J. E. ROCKWELL, *Editor.*
JAMES E. JONES, *Chief Clerk.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

SCIENTIFIC STAFF.

A. J. PIETERS, *Botanist in Charge.*

DAVID FAIRCHILD, *Agricultural Explorer, in Charge of Foreign Explorations.*
W. W. TRACY, SR., *Superintendent of Testing Gardens.*
JOHN E. W. TRACY, *Assistant Superintendent of Testing Gardens, in Charge of Congressional Seed Distribution.*
O. W. BARRETT, *Assistant.*
GEORGE W. OLIVER, *Expert.*
C. V. PIPER, *Agrostologist, in Charge of Forage-Crop Investigations.*
J. M. WESTGATE, *Assistant Agrostologist, in Charge of Alfalfa and Clover Introduction.*
W. W. TRACY, JR., *Assistant Botanist.*
FRANK N. MEYER, *Agricultural Explorer.*
CHARLES F. WHEELER, *Expert.*
A. B. CONNOR, *Special Agent.*
JOHN H. TULL, *Special Agent, in Charge of Matting-Rush Investigations.*
HAROLD T. NIELSEN, *Scientific Assistant in Agronomy.*

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., December 11, 1905.

SIR: I have the honor to transmit herewith a paper entitled "Varieties of Tobacco Seed Distributed in 1905–6, with Cultural Directions," and respectfully recommend that it be published as Bulletin No. 91 of the series of this Bureau.

This paper was prepared by Messrs. A. D. Shamel and W. W. Cobey, in charge of tobacco breeding experiments, Laboratory of Plant Breeding, and it has been submitted by the Botanist in Charge of Seed and Plant Introduction and Distribution with a view to publication.

The illustrations which accompany this paper are considered essential to a full understanding of the text.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

PREFACE.

Following the established policy of this office of improving the methods of distributing seed wherever possible, a departure has this year been made in the handling of the tobacco-seed distribution, the work of selecting the types which it is desired to distribute being undertaken by the tobacco experts of the Laboratory of Plant Breeding of the Bureau of Plant Industry. This, it is believed, will result in placing in the hands of really interested persons the very best seed of the various types of tobacco. Some of these types will be entirely new, the results of selection and breeding by Messrs. Shamel and Cobey during the past two or three years. Other types will be such as are already established, but the seed distributed this year has all been carefully selected with reference to securing the best possible strain of each type.

Special attention has been paid in the present bulletin to a discussion of the methods of growing and handling certain varieties, especially those that are more highly specialized. This course was considered necessary, because even if good tobacco is grown it is easily spoiled by improper handling. It is hoped that those who read these pages will pay special attention also to the discussion of the selection of seed, because the permanent improvement of tobacco types must necessarily be left in the hands of intelligent cultivators, and if careful selection is not practiced by them the work which the Department of Agriculture is doing will fail to attain the full measure of success which would otherwise be possible.

A. J. Pieters,
Botanist in Charge.

Office of Seed and Plant
Introduction and Distribution,
Washington, D. C., December 11, 1905.

CONTENTS.

Page

Introduction 9

Description of varieties 11

Cigar-wrapper tobaccos:

Sumatra 12

Connecticut Havana 12

Connecticut Broadleaf 12

Cigar-filler tobaccos:

Cuban 13

Zimmer Spanish 13

Little Dutch 14

Pipe tobaccos:

North Carolina Bright Yellow 14

Maryland Smoking 14

Plug tobaccos:

White Burley 14

Orinoco and Yellow Mammoth 15

Virginia types (Blue Pryor, Sun-Cured, and White Stem) 15

Directions for culture:

Sumatra tobacco 15

Connecticut Havana tobacco 20

Connecticut Broadleaf tobacco 27

Cuban tobacco 29

Zimmer Spanish and Little Dutch tobaccos 30

Maryland Smoking tobacco 31

North Carolina, Tennessee, and Virginia tobaccos 32

White Burley tobacco 33

Insect enemies 34

Directions for saving seed 34

How to secure good seed 37

Description of plates 40

ILLUSTRATIONS.

Page.

PLATE I. Fig. 1.—Connecticut Cuban tobacco, first year from Cuba. Fig. 2.—The same field shown in figure 1, after saving seed under bag and the selection of the best plants for two years.............. Frontispiece.

II. Fig. 1.—Tobacco seed bed in Florida. Fig. 2.—Tobacco seed beds in Connecticut—tent, hotbed, and cold frame 40

III. Fig. 1.—Transplanting tobacco seedlings with machine. Fig. 2.—Sterilizing soil for tobacco seed beds............................ 40

IV. Fig. 1.—Tobacco seed separator. Fig. 2.—Seedlings from heavy, medium, and light tobacco seed............................... 40

V. Fig. 1.—Method of "spearing" tobacco plants during harvest. Fig. 2.—Wagon rack for transporting plants to curing shed 40

VI. Fig. 1.—Capped plants saved for seed. Fig. 2.—Curing shed in the Connecticut Valley.. 40

VII. Fig. 1.—Seed plant ready for bag. Fig. 2.—Proper arrangement of bag on seed plant 40

VIII. Fig. 1.—Arrangement and structure of tobacco flowers. Fig. 2.—Two strains of Connecticut Broadleaf tobacco, the row on the left from an early parent and the row on the right from a late parent. 40

IX. Fig. 1.—Uniformity in time of maturity and other characters of two types of Connecticut Sumatra tobacco raised from seed saved under bag. Fig. 2.—Lack of uniformity in time of maturity and other characters in ordinary Connecticut Broadleaf tobacco........... 40

VARIETIES OF TOBACCO SEED DISTRIBUTED IN 1905-6, WITH CULTURAL DIRECTIONS.

INTRODUCTION.

In the distribution of tobacco seed by the Department of Agriculture small samples of seed of improved native and standard foreign-grown varieties are furnished for experimental purposes. The object of this distribution in regions where tobacco is not grown at present is to enable farmers to make a reliable test of the adaptability of their conditions of soil and climate to tobacco culture. In the established tobacco-growing sections the growers may secure improved varieties by testing the seed, sent out in this distribution, adapted to the conditions of culture and purposes of manufacture for which the tobacco is grown. The Havana seed tobacco of the Connecticut Valley and the Florida Sumatra type of the southern Georgia and western Florida districts are striking illustrations of the beneficial results of the introduction of new varieties or the importation of standard foreign-grown tobaccos.

Many illustrations might be cited of the importance of testing different varieties of tobacco in the established tobacco-growing sections, and it is the object of this distribution to furnish tobacco growers carefully selected seed of improved strains of standard varieties of tobacco, in order that they may obtain the best types of tobacco adapted to their conditions of soil and climate.

In all cases where foreign-grown or improved native varieties have been successfully established in any region, small crops have been grown until the strains have become adapted to local conditions of climate and soil and a uniform type has been secured by continued and systematic selection of seed.

In the distribution of tobacco seed this season, unless a particular variety of tobacco is requested by the growers an attempt will be made to send the variety of tobacco which experience has shown to be most nearly adapted to the conditions under which the tobacco is to be grown. It has been found by experience that an attempt to produce a tobacco on a soil not suited to the type planted will in most cases result in failure, from the fact that the tobacco produced is unfit for the same grade as the parent plants and will not meet the requirements of an established class of tobacco, but must sell as a nondescript. In some cases, however, new types of tobacco have been established in this way which have proved of sufficient importance to create a market on their own merit, and wherever it seems possible that such results may be secured the seed of highly bred new varieties will be sent to the particular section adapted to the growth of these types.

The tobacco plant readily adapts itself to a great variety of conditions, but is easily affected by the chemical and mechanical conditions of the soil. In fact, it has been found that the relation of the physical conditions of the soil to the texture and quality of the leaf has become so well established that it is possible to determine in a general way by a study of the soil and climate the adaptability of the different sections to a particular type and class of tobacco. The climatic conditions largely influence the quality and aroma in the same way that the soil influences the texture of the tobacco leaf. In a warm climate the tendency is to produce a leaf with a large amount of gum and an aromatic tobacco; in northern sections the leaf becomes larger and finer, but is lacking in aroma. However, these tendencies may be modified in different sections by excessive rainfall, which usually causes a thin leaf and lack of aroma.

As a rule, tobacco which is grown near the sea has poor combustibility, which is supposed to be due to the action of the chlorin in the salt of the sea air. As a general rule, tropical climates produce the best tobaccos for cigar fillers, and temperate climates produce tobaccos which are best adapted for cigar wrappers. In the warmer sections of temperate climates the best smoking and chewing tobaccos are produced.

It has been definitely determined by experiments conducted by the Bureau of Plant Industry that the different types of tobacco can be greatly improved by seed selection and breeding. Inasmuch as the tobacco plant produces a large quantity of seed, it is possible by saving comparatively few plants to furnish enough highly bred seed for the planting of a large area. It is important that where new strains or varieties of tobacco are tested by the growers a small number of plants be grown the first year, in order to test the adaptability of these tobaccos to the local conditions. If the variety proves to be of value the grower can select the best of the individual plants in this small field for the seed of his entire crop the succeeding year.

The importance of growing a small crop from imported or newly introduced seed is illustrated in Plate I. In figure 1 is shown a field in the Connecticut Valley in the season of 1903, grown from freshly imported Cuban seed. It can be seen that in this field there are a large number of "freak," branching, narrow-leaved, and other undesirable types of tobacco for cigar-wrapper purposes. The number of freak plants in this field amounted to one-third the total number of plants and caused the grower a great loss. Specially good plants, free from suckering, were selected for seed in this field, and the seed saved under bag. The crop the following season raised from this seed was comparatively free from freaks and undesirable plants. In 1905 the crop shown in figure 2 from seed saved from the preceding year's selected seed plants of this same variety on the same field was remarkably uniform in type, every plant being like every other plant in the field. A casual inspection of the two figures will show that two years' systematic seed selection, saving the seed under bag, has served to weed out all of the freak and undesirable types and has enabled the grower to produce a uniform field of a highly desirable type of tobacco.

There is no general farm crop which responds so readily to seed selection and breeding as tobacco. The transmitting power of the individual parent plants is exceedingly strong, and the progeny of the individual seed plants show great uniformity when seed is saved under bag according to the plan outlined in the following pages.

It is exceedingly important that strains of tobacco be secured in different sections resistant to the "root knot," "root wilt," and other fungous diseases which attack the tobacco crop. In the experiments conducted by the Bureau of Plant Industry it has been found that by saving the seed of resistant plants under bag it is possible to produce uniform strains which are immune to the attack of most root diseases. Wherever possible the Department will undertake to make selections of resistant types and furnish small quantities of this seed for distribution.

It is advisable for tobacco growers to secure and test new varieties in different sections, and especially to secure hybrids of the native with the imported varieties. In order to safely introduce these hybrids it is essential to grow a few plants of the desired imported variety in order to procure pollen for crossing. In no instance should a large area of plants be grown from the first year's cross or from the imported seed. One hundred plants of each type or variety will give a fair indication of the nature and value of the cross or importation, and will furnish sufficient plants for seed selection for the next year's crop. After the grower secures a uniform crop of the desired kind sufficient seed may be saved for future crops in accordance with the directions given in this bulletin.

DESCRIPTION OF VARIETIES.

It is impossible to recommend the best variety of tobacco for growing in a new region, that being a matter which can only be determined by careful experiments. If the soil and climatic conditions are known, a study of the description of the varieties sent out in this distribution will enable the grower to select a variety which will be adapted most nearly to the new conditions. In the following list the best varieties for testing by the growers are grouped with reference to their uses and the character of soil which produces the best yield of each variety, as determined by past experience.

CIGAR-WRAPPER TOBACCOS.

Sumatra.—Used wholly for the production of high-grade cigar wrappers and not considered of any value for fillers. In the United States this variety is grown under slat or cloth shade. Adapted to sandy loam soil. In western Florida, where it is grown extensively, the surface soil is underlaid by a red clay subsoil. The leaves are very thin, of fine texture, with small veins, and vary from 12 to 20 inches in length and 8 to 16 inches in width. The plants bear from 16 to 30 leaves, with comparatively long internodes. The leaves have an erect habit of growth. Under favorable conditions for growth the plants reach a height of from 7 to 9 feet. This variety produces the best grade of domestic cigar wrappers.

Grown in western Florida, in southern Georgia, and in the Connecticut Valley.

Connecticut Havana.—Used for cigar wrappers and binders, and the top leaves are frequently used for fillers in the inferior grades of domestic cigars. Adapted to light alluvial, sandy soils, containing a small percentage of clay, and as a rule the less the clay the higher the yield of fine cigar wrappers. Where this variety is grown for fillers a rich clay yielding a heavy crop of leaf is probably the most desirable type of soil. The leaves are thin, of fine texture and delicate flavor, set very close together on the stalk, with very short internodes, and have a very erect habit of growth. The plants bear from 10 to 15 leaves, varying in average length from 20 to 32 inches and in average width of from 10 to 15 inches. This variety was secured by continued seed selection from crops grown from seed imported from Cuba, and is probably a cross between these Cuban plants and the native Broadleaf of the Connecticut Valley.

Grown in the Connecticut Valley, Wisconsin (mainly for binders), Ohio, Pennsylvania, and New York. One of the best general-purpose tobaccos.

Connecticut Broadleaf.—Formerly known and generally recognized in the trade as Seedleaf. Used for cigar wrappers and binders, and the lower grades, to a limited extent, for blending with other tobaccos for cigar fillers. Adapted to sandy loam soil. This variety makes an exceedingly rapid growth. The leaves are very broad, sweet tasting, thin, elastic, silky, and with small veins. The leaves are set very close together on the plant, having a very characteristic drooping habit of growth, and vary in length from 24 to 36 inches and in width from 12 to 22 inches. The size of leaf varies greatly in different sections and with the different strains which have been developed by individual growers. The seed of this variety has been sent to many sections of the United States and a large number of important varieties have been secured from this source, as in the case of the Ohio Seedleaf, which can be traced directly to Connecticut Broadleaf seed.

Grown in the Connecticut Valley, New Hampshire, Vermont, New York, Pennsylvania, Ohio, Wisconsin Minnesota, and to a slight extent in Indiana and Illinois.

CIGAR-FILLER TOBACCOS.

Cuban.—Used for high-grade cigar wrappers when grown under shade, but is generally grown outside for cigar fillers. Adapted to alluvial or sandy soil resting on red clay subsoil. This variety has a small leaf of fine texture. The leaves are short and round, with small veins, medium to heavy body, varying from 10 to 18 inches in length, and 6 to 14 inches in width. When this variety is taken north the influence of the climate and soil conditions tends to promote the development of a large leaf at the expense of fineness of texture and quality. When grown from freshly imported seed in southern tobacco districts the tobacco seems to retain the valuable qualities of flavor, aroma, smooth taste, and other characters of the imported Cuban tobacco. Whether these qualities can be retained by continued selection of seed from desirable plants is a subject for experimentation, but the evidence obtained up to this time indicates that it is probable that in certain districts in the United States uniform crops of Cuban tobacco having a highly desirable flavor and aroma can be produced by the aid of systematic seed selection.

In the Connecticut Valley this variety is grown under shade for cigar wrappers, the top leaves being used to a limited extent for cigar fillers, and it is grown for cigar fillers in Florida, Texas, Ohio, and Georgia. In Florida and Texas it produces one of the best grades of domestic fillers.

Zimmer Spanish.—Largely used for cigar fillers, and is the most popular and extensively grown domestic filler. It is frequently used for blending with other tobaccos in cigar fillers. It is commonly believed to be a hybrid of the native Seedleaf and the Cuban variety. Adapted to light loam soil, and in the Miami Valley, Ohio, where this variety is most extensively grown, the surface soil is underlaid by a red-brown clay loam. The leaves are medium in size, have good body and elasticity, with small veins, and they resemble the Cuban variety. The leaves are set close together on the stalk, from 14 to 20 leaves to the plant, the plants reaching an averge height of about 4 feet. This variety produces an average yield of about 600 pounds to the acre and brings an average price of about 7 cents a pound.

Grown in Ohio and Wisconsin.

Little Dutch.—Used for cigar fillers, making a cigar with an aroma resembling the Yara tobacco grown in eastern Cuba. Adapted to clay loam soils. The seed was introduced in this country from Germany. The leaves are small and narrow and the plants have a short habit of growth, producing a light yield. This tobacco requires careful curing and fermentation.

Grown in Ohio and to a limited extent in Pennsylvania.

PIPE TOBACCOS.

North Carolina Bright Yellow.—Used for manufacturing plug and smoking tobaccos, cigarettes, and for export purposes. This variety is adapted to sandy soils, underlaid by a red or yellow clay subsoil. The deeper the sand the brighter the tobacco produced, and the nearer the surface the subsoil comes the more inclined the tobacco is to darken in color. The leaves are light and spongy, of rather thick texture, set close together on the stem, with an erect habit of growth, but drooping at the ends, the tops often touching the ground. This variety is a modified type of the native Maryland and Virginia tobaccos.

Grown in North Carolina, Maryland, Virginia, and South Carolina.

Maryland Smoking.—Used for manufacturing and export purposes. Adapted to clay loam and sandy soil. The leaves are thick and coarse in texture, but are light and chaffy when cured. They have a semierect habit of growth, drooping at the tips, varying in length from 20 to 36 inches and in width from 10 to 26 inches. The plants bear from 10 to 18 leaves and reach an average height of about 4 feet. This variety was discovered in Maryland when the first settlers explored that region. It is mostly exported to France, Germany, and Holland.

Grown in Maryland, Virginia, and Pennsylvania. From the Maryland tobacco many of the important native varieties have been developed by growing in different tobacco-growing sections and by continued selection of seed for a particular type of tobacco.

PLUG TOBACCOS.

White Burley.—Used for plug fillers and wrappers for smoking and for the manufacture of cigarettes. Adapted to well-drained, deep-red clay-loam soil. In Kentucky such soils are fairly rich in lime and produce good crops of corn, wheat, hemp, and grass, but they deteriorate rapidly unless the fertility is maintained by the use of fertilizers and proper methods of cultivation. The leaves are long and broad and have a white appearance in the field. They have a horizontal habit of growth, the tips hanging down and often touching the ground. They vary in length from 28 to 36 inches and in width from 16 to 24 inches. The plants bear from 10 to 18 leaves and reach an average height of about 4 feet in the field. This variety is a selection from the original Burley, the peculiar white, translucent appearance of the original parent plant having attracted the attention of the growers. Seed saved from this plant produced a large number of plants the following season, and in time a large and important industry was developed from this beginning.

The Red Burley and dark tobaccos of southern and western Kentucky and Tennessee are heavy tobaccos, nearly related to the White Burley, but on account of their peculiar characteristics are largely exported.

Grown in Kentucky, southern Ohio, Tennessee, and to a limited extent in North Carolina and Virginia.

Orinoco and Yellow Mammoth.—Used for plug wrappers and fillers and are stemmed for export trade. Adapted to rich, well-drained soils, doing especially well on alluvial soils underlaid with red clay subsoil. The Orinoco variety has short, broad leaves, while the Yellow Mammoth has large leaves, both varieties having a rapid rate of growth. The Little Orinoco type has a long, narrow, tapering leaf, and is the sweetest variety grown. The Yellow Mammoth is largely exported for Swiss trade, and its culture is mainly confined to Tennessee.

The Orinoco type is grown in Virginia, North Carolina, Tennessee, West Virginia, and Missouri.

Virginia types (Blue Pryor, Sun-Cured, and White Stem).—Adapted to sandy soil, underlaid with red or yellow clay subsoils. These types have very broad, large, fine leaves, of fine, silky texture, with rather tough fibers and usually have bright, fine colors. Some of the best grades are used for cigar wrappers and others for smoking purposes.

Grown in Virginia, North Carolina, Kentucky, Tennessee, Missouri, and Indiana.

DIRECTIONS FOR CULTURE.

SUMATRA TOBACCO.

The location selected for the seed bed should have a slightly southern exposure in order to get the full benefit of the warm rays of the sun in the early spring. The slope should be sufficient to insure perfect drainage at all times. It is desirable that the seed bed be surrounded by board walls and covered with regular tobacco tenting cloth, an illustration of which is shown in Plate II, figure 1. The cover will protect the tender plants from the cold north winds and produce more uniform and favorable conditions, insuring early, rapid growth. The location should be permanent, abundantly fertilized every spring, and kept free from weeds and grass at all times. The soil becomes better adapted to plant-bed purposes each succeeding year if this method is followed. The most desirable soil seems to be a rich, friable sandy loam. Deep plowing or spading should be avoided in the preparation of the soil, the usual depth being 4 or 5 inches. The ground should be harrowed and stirred with hand rakes until thoroughly pulverized, and all roots, tufts, and clods of earth should be carefully removed.

After this preparation a liberal application of fertilizer rich in nitrogen and potash should be evenly distributed over the bed. A fertilizer containing 10 per cent of ammonia, 8 per cent of available phosphoric acid, and 12 per cent of soluble potash is highly recommended. Chlorin in any form must be avoided. After applying this fertilizer the bed should be thoroughly stirred again and left very smooth, in which condition it is ready for the seed. It is customary to sow the seed at the rate of about 1 tablespoonful to 100 square yards of seed bed. It is impracticable to sow this seed alone and it should be thoroughly mixed with wood ashes, corn meal, land plaster, or commercial fertilizer. In order to obtain a uniform stand of plants it is advisable to sow half of the seed lengthwise of the bed and the remainder crosswise.

The proper time for sowing the seed is from February 1 to March 1. Wherever practicable it is best to prepare the land and apply the fertilizer from one to two weeks before sowing the seed. After sowing, a light roller should be run over the bed, or some other means used to get the soil in a firm, compact condition, in which state it will retain its moisture, thus giving more favorable conditions for the germination of seed and the growth of the young plants. The necessity of properly caring for the seed bed can not be too strongly emphasized, since nothing is of more importance in obtaining a vigorous growth in the field than strong, healthy seedlings. They should be made to grow steadily and vigorously without being checked until ready for transplanting. In order to obtain this condition, strict and constant attention must be given to watering the bed, keeping down all weeds and grass, and preventing the ravages of insect pests. In some cases it is necessary to use an additional application of fertilizer in the way of a top-dressing. The necessity for this is often indicated by the plants turning yellow. The fertilizer should be essentially of the same composition as that previously used, and often gives best results when applied in a liquid form. This method of application makes it necessary to wash the fertilizer thoroughly into the soil by means of an abundant spray and thus avoid injury to the tender plants.

Whenever it is found that the plants are too thick in the bed it is advisable to thin them out by drawing an ordinary rake across the bed, allowing it to sink to a depth of from one-half to three-fourths inch. This can be done without seriously injuring the remaining plants and is, in fact, of positive benefit to them. In all cases some system should be provided for watering the plant beds during spells of dry weather.

Water should be applied in the form of a light spray. During the first two weeks of plant growth it is essential that the surface soil be kept comparatively moist at all times, for at this stage a few hours of hot sun, after the soil has become dry, will be sufficient to kill most of the plants. Where irrigation is used in growing the general crop a system of overhead spray nozzles has been found to give excellent results.

As has been previously mentioned, great care must be taken to remove all weeds and grass that may appear among the young plants. In every case, before undertaking the process of weeding the bed, it is most important to water thoroughly. This will prevent any serious injury being done to the roots of the tobacco plants.

One of the most injurious insects to be guarded against in the cultivation of the seed bed is a flea-beetle. The injury to the plants by this insect may be prevented by the use of a light spray of Paris green. The mixture should be made at the rate of 1 pound of Paris green and an equal quantity of quicklime to 100 gallons of water, which should be kept constantly stirred when in use. The same remedy can be applied in the case of the hornworm, where the seed bed is not inclosed or covered.

A very satisfactory fertilizer consists of 1,000 pounds of cotton seed, 1,000 pounds of cotton-seed meal, 300 pounds of carbonate of potash, 700 pounds of fine-ground bone, and 800 pounds of lime to the acre. The cotton seed should be put on the field after it has been plowed and three weeks or one month before it is finally prepared for transplanting. Wherever it can be obtained cow-pen manure should be used broadcast at the rate of 20 to 25 loads per acre. Cow-pen manure promotes very rapid growth and often becomes the means of securing a good crop of tobacco on land badly infested with nematodes. This kind of plant food enables the plant to throw out new roots faster than the nematodes can destroy the old ones.

When produced for wrapper purposes the Sumatra variety of tobacco is usually grown under shade. The purpose of the shade is to protect the crop from insects and other dangers and by reason of reducing the light to secure a thin leaf. The effect of the shade is also shown in influencing the humidity of the atmosphere and the temperature. The plants under shade show a much more rapid growth than the outside tobacco, and the leaves are finer, very thin and elastic, and with very small veins. Such characteristics as these in wrapper tobacco are desired by manufacturers.

Where no cover crop is grown during the winter the land should be plowed frequently and kept thoroughly stirred. This destroys many of the nematodes, and in that way greatly reduces the damage due to these insects the following year. This constant cultivation also prevents, to some extent, the depredations of the thrips; it prevents the growth of grass and weeds, which serve as host plants for this insect.

The preparation of the soil for Sumatra tobacco must be thorough and complete. The soil should be thoroughly pulverized by successive plowing and harrowing, and reduced to a fine condition before transplanting. Deep plowing and subsoiling causes a retention of moisture in the soil if the season is too dry, and at the same time affords the best opportunity for proper drainage if there is an excess of rainfall during the growing season. The disk plow and disk harrow have been used very successfully in the preparation of tobacco soils, particularly where the content of clay is comparatively small.

When transplanting the young plants from the seed bed to the field, it is desirable to make a selection of the best and most vigorous plants in the seed bed. At this early stage of growth the most vigorous plants, having the largest and best-shaped leaves, can be very easily distinguished by the grower and selected for the field.

The ordinary distance for Sumatra under cloth is 3 feet 3 inches apart for rows and 12 inches apart in the row. Under slat shades the distance between the plants in the row is usually increased to about 14 inches.

Before removing the young plants from the seed bed, the bed should be thoroughly watered and the plants taken out with all possible care. In setting the plants in the field care should be taken to avoid bending and doubling the roots, and the necessary application of water should not be overlooked. It is often found beneficial, just before transplanting, to water the soil where the plant is to be set, and to water again shortly after transplanting.

The cultivation of the crop should include the removal of all weeds from the field, particularly during the early stages of growth, and a thorough cultivation of the soil at frequent intervals in order to keep a loose mulch on the surface of the soil. It is usually the custom to hoe the young plants twice and to use some form of cultivator at least once a week during the remainder of the season until the plants have become too large for cultivation. In many instances it has been found desirable and practicable to cultivate the tobacco until shortly before the top leaves are taken off. In dry seasons this serves to retain the soil moisture by preventing excess evaporation due to soil capillarity.

When the plants begin to bud, all except the individual plants saved for seed purposes should be topped. No very definite rule can be given for this process, but it is the usual custom to break off the top of the plant just below the first seed sucker. The height of topping must be largely governed by the local soil and climatic conditions.

It is necessary to remove the suckers before they reach sufficient size to seriously injure or dwarf the plant or interfere in the development of the leaves. In most cases it will be found necessary to remove the suckers two or three times, and more frequently if the season is one which promotes rapid growth. If seed is to be saved on any of the plants, the flower cluster should be covered with a light and strong paper bag before any of the flowers blossom out, in order to prevent cross-fertilization. The bags should be kept in good condition and not allowed to injure the top of the plant in any way. They should remain over the flowers until a sufficient number has been fertilized to produce a good supply of seed.

The time for harvesting will depend to a considerable extent upon the season, but the ripeness of the leaves can be distinguished by the development of irregular, light yellowish colored patches over the surface and a thickening and crumpling of the body of the leaves. The leaves should be harvested before they become overripe, and it is the usual practice to pick them at three or four different periods, the lower leaves maturing first, the middle leaves next, and the top leaves last, generally allowing from six to eight days between each picking. After picking, the leaves are carried to the curing shed in baskets made for this purpose and are strung on 4-foot laths specially arranged for them at the rate of 30 to 40 leaves to the lath. The leaves are arranged back to back and face to face, and are regularly strung on the cord attached to the lath. The laths are then hung in the curing shed, where the leaves are allowed to thoroughly cure out.

When the tobacco is primed from the stalk it should not take more than three weeks to cure; when it is hung on the stalks from four to six weeks are necessary. The manipulation of the curing barn is governed entirely by the condition of the weather and the nature of the tobacco, so no fixed rules can be given. However, in a general way it can be said that the barn should be opened during the day and kept closed at night. If there are frequent showers and but little sunshine, the barn should be kept closed and small fires started, distributed throughout the building. These fires should be continued as long as it is necessary to dry out the entire barn of tobacco. Where charcoal is not available, wood which has as little odor and as little smoke as possible should be used. It is very important to dry out the barn without giving the tobacco any foreign odors. To obtain the best results the tobacco should become moist and be fairly dried out once in every twenty-four hours.

When the midribs are thoroughly cured the leaves are ready to be taken to the packing house. To get the tobacco in condition to handle, all the ventilators should be left open for one night, opening them about 6 o'clock in the evening. Unless the night is a dry one, the tobacco will soften before morning and be in condition or "good order;" that is, it will have taken up sufficient moisture to make it soft and pliable. The barn should then be tightly closed, in order to retain the moisture, and the leaves taken from the laths and tied into hands of convenient size. The bottom, middle, and top leaves should be kept separate in the barn. After the tobacco has been taken down and packed it should be taken at once to the warehouse for fermentation.

The fermentation of the tobacco is to be done in bulk, and this sweating process must be watched with unusual care in order to prevent disaster to the crop. It is necessary to turn the bulk several times during the process of fermentation in order to keep the temperature at the desired point. The object of turning the bulk is to reverse its construction, thereby bringing the top, bottom, and outside layers into the middle of the new bulk. This plan will permit a uniform fermentation of all the tobacco in the bulk. A convenient and practical size of bulk contains from 2,000 to 3,000 pounds. The temperature of the center of the bulk should in no case be allowed to rise above 120° F., and after the temperature falls from 8 to 10 degrees the bulk should be turned. The desirable maximum temperature is 115° F. It takes usually from six to eight weeks to complete the process of fermentation. After fermentation the tobacco must be sized, sorted according to the different market grades, tied up in hands, and packed.

CONNECTICUT HAVANA TOBACCO.

There is a very limited amount of plant food in tobacco seed on account of the small size of the individual seed, so that the reserve material for the nourishment of the young plants is soon exhausted: consequently the tobacco seedlings are forced to prepare their own food much sooner than is the case with most other crops. For this reason it is absolutely necessary for tobacco growers to get the soil and plant food in the seed beds in the best possible condition for use by the young plants in order to aid the slow-growing young plants during the critical period of the first stages of growth. The seed beds should be located so that they will get all the benefit possible from the warm rays of the sun during the early spring days, as well as protection from the cold north and northwest winds prevalent at that time of the year. A southern slope where good drainage can be secured is preferable, and a good, rich, and friable soil is desirable for the tobacco seed beds.

As a rule 200 square feet of seed-bed space should be provided to furnish sufficient seedlings for an acre of tobacco, although if the tobacco is to be transferred at different periods a less area will be found to be sufficient. The seed beds are generally 8 feet wide and as long as is necessary to furnish sufficient seedlings for the field. They are usually laid out from east to west.

The framework of the seed bed is usually made of 2 by 12 inch boards, set in the ground from 3 to 4 inches, one side being sunk 2 inches lower than the other in order that the sash may lie over the top of it in a slanting position, so that the plants will receive all of the sunlight possible.

The best method of covering the bed is by means of glass in sash about 3 feet wide by 8 feet long. These sash are laid over the top of the framework and of course can be removed at any time when it is necessary. In some cases heavy cheese cloth or tobacco cloth is substituted for the glass covering, but the temperature of the beds can not be regulated so well as with the glass cover, and the cloth should not be used where very early plants are desired. It is claimed by old tobacco growers, however, that the plants raised under cloth are more hardy than those raised under glass, and it is a frequent practice to grow the early plants under glass and the later seedlings under cloth. In Plate II, figure 2, are shown the cloth tent seed bed, the cloth-covered cold-frame seed bed, and the glass-covered seed bed, which are most practicable and successful for the raising of seedlings.

When it is necessary to water the seed bed the sash are removed temporarily and the water is applied in the form of a fine spray. As soon as the watering is completed the sash are replaced in their original positions. If it becomes necessary to air or cool the beds one or more sash can be raised until the desired object is accomplished.

The soil for the seed bed should be a light sandy loam, as free from weed seed, fungous diseases, and insect pests as possible. It has been found that by sterilizing the soil used in the seed bed the expense of weeding the beds can be done away with. The sterilization of the seed-bed soil results in the production of better plants than are grown in soil which has not been sterilized and also destroys the fungous spores which frequently interfere with the successful raising of young plants. In Plate III, figure 2, is shown a simple and practicable method of sterilizing the soil with steam. The upper 6 inches of the soil in the seed beds is removed and placed in an ordinary wagon box, in the bottom of which three perforated pipes are laid and attached to a steam boiler. The sterilization process requires about 40 minutes for each wagon box of soil, the time being determined by placing a potato in the soil and supplying steam until the potato is baked. A large quantity of surface soil in the seed beds can be sterilized in this manner in a comparatively short time with little expense.

A successful method of heating seed beds is by the use of fresh horse manure. In this case the beds should be dug out 2 feet deep about a week before the time for sowing the seed. The fresh manure should be packed in this space to a depth of 1½ feet and covered with 6 inches of the sterilized soil. Another successful method of heating the seed bed is by the use of hot-water or steam pipes, laid around the sides of the bed or under the surface of the soil. General experience has proved, however, that the manure beds are equal in value, if not superior, to the artificially heated ones, mainly from the fact that the heat is distributed evenly through the soil in the seed bed, while in the case of hot-water or steam pipes the surface of the bed or the air space is likely to be hot while the soil may remain cold and in poor condition for the growth of the young plants.

The soil for the seed beds should be fertilized with a highly nitrogenous fertilizer, the one most commonly used being cotton-seed meal in combination with a complete fertilizer containing phosphoric acid and soluble potash. This fertilizer should be thoroughly worked into the soil.

In preparing the soil for the sowing of the seed, it should be most carefully handled, so that at the time of sowing it is in a fine, loose, and friable condition, with an even surface. As the tobacco seed is very small, it is necessary to have the soil in the finest possible tilth in order to present a uniform condition for the seed. During the growth of the young plants it is well to sprinkle over the beds a light dressing of nitrate of soda, dissolved in water, after which it should be washed into the soil with a light and fine spray of water. It is sometimes found desirable to add a light application of phosphorus, in the form of ground bone and carbonate of potash, if the soil is found to be deficient in these elements of plant food. It is the usual practice in the North to sprout half of the quantity of seed used for sowing in moist but not too wet apple-tree punk or rotted cocoanut fiber about one week before the time for sowing the bed. For this purpose the seed is thoroughly mixed with the punk and placed in a glass jar, which should be kept in a warm room. The seed will sprout quickly in this medium, and it is probable that earlier plants can be secured from such sprouted seed than from sowing the dry seed alone. The sprouted seed should be sown about the time the sprouts are one-eighth to one-fourth inch in length. Many growers sow the sprouted seed as soon as the seed coats burst and the sprouts appear. If the sprouts become too large they will be injured during the process of sowing. An equal quantity of dry seed should be mixed with the sprouted seed when the beds are ready for sowing.

It has been found by comparative tests made by the Bureau of Plant Industry that in most cases the dry seed produces plants about as early as the sprouted seed, and the plants from the dry seed are more uniform in size and apparently more hardy than those raised from the sprouted and dry seed combined. In order to get an even distribution of seed over the seed bed in sowing, it is a good plan to mix the dry seed and the sprouted seed with several times its bulk of land plaster or gypsum, or, if this is not obtainable, corn meal or ashes, so the seed can be sown more evenly over the bed. One to two tablespoonfuls of seed should be used for every 100 square yards of seed-bed surface.

After sowing the seed it is desirable to pack the surface of the bed carefully with a roller or heavy plank, in order to press the soil closely about the seed. Another good plan is to cover the seed by lightly raking the surface with an ordinary garden rake, and this method is preferred by many experienced growers. It has been found in the experiments of the Bureau of Plant Industry that the light seed is undesirable and in every case should be separated from the heavy seed and discarded. In order to make a thorough and complete separation, it is necessary to use some form of a wind-blast machine which will blow out the light seed without throwing out the heavy seed at the same time. In Plate IV, figure 1, is shown a satisfactory seed separator, by the use of which the light seed can be separated from the heavy seed and discarded, and the heavy seed used for sowing the seed beds. The heavy seed produces the most vigorous and uniform young plants in the seed beds, as shown in Plate IV, figure 2, and these plants are most desirable for use in the case of all varieties of tobacco.

The Havana seed variety of tobacco is usually sown in the seed bed from the middle of March to the middle of April, and the plants are ready for setting out from these beds from May 10 to June 10.

One of the most important points in the raising of a successful crop of tobacco is the care of the seed bed in the production of the seedlings. It is necessary to water the seed bed frequently, usually once or twice every day during the early stages of growth. If the beds are artificially heated, warm water should be used for this watering process, as cold water cools the beds and checks the growth of the young plants. The surface of the seed bed should not be allowed to become dry, as a few hours of dry surface will kill all of the young plants. The water should be supplied in the form of a light spray, in order not to disturb the seed or the young plants in the bed or to pack the soil so that in drying it will cake and injure the plants.

The temperature of the hotbeds should be carefully regulated, and in no case allowed to rise above 100° F. during the day or fall below 70° F. during the night. If it is possible to maintain an even temperature the plants will make the most rapid growth, but it is a question whether they will be as hardy as when subjected to the fluctuating temperatures corresponding to the natural changes between night and day. The beds can be cooled when necessary by raising the sash if the temperature rises, or the temperature can be raised at night by using lanterns set 5 or 6 feet apart in the seed bed and by covering the sash with heavy cloth, such as ordinary blankets, in order to retain the heat. After the young plants reach the proper size for setting out, usually from 5 to 6 weeks after sowing in the seed bed, the sash can be taken off most of the time during the day and the beds watered only when the plants begin to wilt. If the plants come up too thick in any portion of the seed bed, they should be thinned out by using an ordinary garden rake and pulling it through the thickly set plants. Sufficient plants will be removed in this way, and those which remain will not be injured by the thinning process, but will be benefited by the stirring of the surface soil. It is also necessary to keep out all weeds, carefully pulling them as soon as they appear among the tobacco plants. Before pulling the weeds, the beds should be thoroughly watered. If flea-beetles or other biting insects attack the young plants in the seed bed, the plants should be sprayed with a Paris green mixture at the rate of 1 pound of Paris green and an equal quantity of quicklime to 100 gallons of water. If fungous diseases begin to grow in any portion of the seed bed, it should be thoroughly aired by raising the sash during the day, and if this method does not check the growth of the fungus the beds should be sprayed with a solution of formalin—1 part of formalin to 2,000 parts of water. An application of lime dusted over the beds will also assist in preventing the spread of fungous diseases.

The preparation of the field for the plants should be begun in the autumn, if possible, by plowing the land 2 or 3 inches deep and sowing a cover crop, such as vetch or some other legume. These leguminous cover crops not only prevent washing and loss of fertility during the heavy rains of the fall and winter, but increase the fertility of the soil through the addition of the nitrogen in the tubercles of these plants and by reason of their extensive root development, which tends to break up and put the soil in the best possible tilth for the young plants. In the spring the land should be replowed, care being used to see that the cover crop is thoroughly plowed under, with an application of well-rotted stable manure at the rate of 12 to 15 tons to the acre.

In addition to the use of stable manure, it has been found that the following or a similar fertilizer should be used in order to secure the best results: One ton of cotton-seed meal, 200 pounds of carbonate of potash, 500 pounds of starter, and 1 barrel of lime to the acre. This commercial fertilizer should be sowed on the land after plowing and worked into the soil with a disk or by some other means of thorough stirring before the young plants are transplanted into the field. When the young plants are pulled from the seed beds the bed should be thoroughly wet down before pulling, in order that as little injury to the plants as possible may be inflicted during the process of pulling. The plants are usually set out with a tobacco setter, such as is shown in Plate III, figure 1. If possible, it is desirable to transplant after a shower or during a moist spell of weather, as the hot sun on the young plants in the fields is likely to cause considerable injury. Immediately after transplanting, the young plants should be dusted with a bran mash and Paris green mixture made by mixing thoroughly 1 pound of Paris green with 100 pounds of bran. This mixture can be applied to the plants by dusting through a perforated tin box, or in some cases a small fertilizer sower is used for this purpose.

In transplanting the young plants from the seed bed it is desirable to make a selection of the best and most vigorous plants. At this early stage of growth the differences in shape of leaf can be detected by an inspection of the seedlings. For the Havana Seed variety the plants should be set in rows 3 feet 3 inches apart, and the plants should be set 18 inches apart in the row. If the plants are set by hand great care should be used not to bend or otherwise injure the roots of the young plants, as such injury may result in a diseased condition of the plant, making it almost worthless for wrapper purposes.

In cultivating the field a shallow or surface cultivator should be used and the soil kept stirred frequently in order to conserve soil moisture, as well as to remove all weeds. It is usually found necessary to hoe the field once or twice during the early stages of growth in order to remove all of the weeds and to loosen the soil around the young plants and keep it in the best possible condition for their most favorable growth.

When the plants begin to bud all except the individual plants saved for seed purposes should be topped. No very definite rule can be given for this process, but it is the custom to break the tops off the plants just below the first seed sucker. As a rule the height of topping must be governed by local conditions, such as the soil fertility and the season. In most cases two or three of the top leaves are removed in topping. It is necessary to remove the suckers before they reach sufficient size to seriously injure or dwarf the plant or interfere with the development of the leaves. It will usually be found necessary to remove the suckers two or three times during the season in order to keep the plants free from these injurious branches.

It has been found in the tobacco-breeding investigations that by selecting seed from plants having few suckers, sucker-resistant types of tobacco can be secured, and it is recommended that in the case of all of the wrapper varieties of tobacco, particularly the Havana Seed tobacco, such a plan of seed selection be followed. In saving seed from carefully selected plants the flower clusters should be covered with a light and strong paper bag before any of the blossoms open, in order to prevent accidental cross-fertilization. These bags should be of light but strong paper, and should be kept in good condition and moved up the stalks occasionally so as not to allow the bags to injure the tops of the plants in any way. These bags should remain over the seed head until all of the flowers that are to be used for seed-saving purposes have been fertilized, after which the bags can be removed and the seed allowed to mature in the open.

The time for harvesting this variety of tobacco varies with the season, but the ripeness of the leaves can be distinguished by the development of irregular, light yellowish colored patches over the surface and a thickening of the body of the leaves. By crumpling the leaf, if the surface breaks in straight lines, or "cracks," as the old growers are accustomed to call it, the leaf is said to be in proper shape for cutting.

The plants are usually cut with a regular tobacco hatchet or knife and are strung on laths, as shown in Plate V, figure 1. Five or six plants are usually strung on each lath, after which they are hauled to the sheds in wagons specially prepared for this purpose. A wagon with special rack arranged for transporting the plants from the field to the curing shed is shown in Plate V, figure 2. These laths are usually 4 feet in length, and are so hung in the curing shed that a space is left between each plant in order to get a circulation of air. A common type of curing shed filled with tobacco is shown in Plate VI, figure 2.

The curing process requires as a rule from 4 to 6 weeks. The manipulation of the barn or curing shed during this period is entirely governed by the conditions of weather and the nature of the tobacco, so that no fixed rules can be given. However, in a general way it can be said that if the barn is filled with green tobacco and the weather is hot and dry the ventilators should be open most of the time for about 3 days, by which time the tobacco should begin to yellow. The ventilators should only be closed to prevent too rapid curing during this period. The barn should then be opened at night and kept closed during the day. This is done to prevent too rapid curing, which destroys the life of the leaf and produces uneven colors in the tobacco. If there are frequent showers and but little sunshine the barn should be kept closed, and if there are indications of pole-burn or pole-sweat, small fires, at least two in every bent in the shed, should be started. In order to dry out the tobacco in as short a time as possible, these fires should be distributed throughout the shed and the tobacco above the fires protected by hoods. The best material for making these fires is probably charcoal or coke, but if these two materials can not be used soft pine wood may be found to be satisfactory. In no case should hard wood be used, as certain odors are given off which it is impossible to get out of the tobacco, and these injure the quality and the sale of the crop. To get the best results, the tobacco during the curing process should be kept fairly moist and fairly dried out once in every 24 hours.

After the curing process has been finished the tobacco is usually sorted according to grade and color as laid down by the tobacco trade. The tobacco is then arranged in hands and packed in cases, where it is allowed to go through natural fermentation, or it is placed in a room which can be heated and is there put through a forced sweat. If the natural fermentation takes place it usually does not begin until the warm weather of the succeeding summer. Great care must be used in the fermenting processes that the tobacco is not damaged by the spread of fungous diseases, mold, or other causes of injury to tobacco in cases. The cases are usually arranged to hold about 350 pounds of tobacco.

CONNECTICUT BROADLEAF TOBACCO.

The methods of sowing the seed, preparation of the seed beds, and treatment of the beds are practically the same for the Connecticut Broadleaf as in the case of the Connecticut Havana variety. Many of the growers in the Connecticut Valley prefer the tent cover for the seed beds for this variety, two forms of which are shown in Plate II, figure 2. The advantage in the cheese-cloth or light-muslin cover for the seed bed lies in the fact that plants grown under such conditions are as a rule more hardy than plants raised under glass. As the Broadleaf plants make a very rapid growth in the seed bed and field, hotbeds for the production of early seedlings are not as essential as with other slower growing varieties. To sow the seed mix one tablespoonful for every hundred square yards of seed bed with 2 quarts of ashes or meal in order to get an even sowing, and lightly rake the surface of the bed so as to barely cover the seed. If the seed is covered too deep, it will not germinate.

The seed bed should be kept moist, but not too wet, as too much water not only injures the seed, but favors the development of fungous diseases. In about two weeks after sowing, the young plants will appear, but at this time they make a very slow growth, as the plant food in the seed has been exhausted and the plants must meet new conditions. At this stage, if the surface of the bed dries out, the young plants will be killed, so that it is absolutely necessary to use the greatest possible care in watering the beds. After the young plants have developed root systems and become established for independent growth they make a very rapid growth, and it is usually desirable to apply liquid manure. If the seedlings begin to turn yellow, it is a sign that more plant food is necessary, and this can be applied in liquid form. The young plants should be set out when the leaves are about five inches long. Large plants are not desirable, as they grow spindling, while very small plants are likely to die after transplanting if any unfavorable conditions develop. In transplanting, the beds should be thoroughly watered before pulling the plants in order to avoid disturbing or injuring the roots. After pulling the plants they should be placed in a basket, roots downward, and set in a shaded, cool place until set out in the field.

The preparation of the land for planting should be thorough, and the soil should be in as good tilth as possible. Cover crops, such as vetch, are desirable for plowing under. A disk cultivator is a good implement to fine the surface soil, after which the land should be fitted with drag and harrow, in order to get the surface as level and fine as possible. The land is usually fertilized with well-rotted barnyard manure, at the rate of from 8 to 12 tons per acre, plowing it under in the spring. Frequently tobacco stems, at the rate of from 500 to 600 pounds per acre, are used as a fertilizer in the Broadleaf sections. Most crops of Broadleaf tobacco are grown on these fertilizers alone, but in recent years the growers have begun to apply about 1 ton of cotton-seed meal, 200 pounds of carbonate of potash, and from 1 to 2 barrels of lime per acre in addition to the usual tobacco starter.

The seedlings of the Broadleaf variety are usually set in rows 4 feet apart and the plants from 22 to 24 inches apart in the rows. In all cases water should be used in transplanting, even if the ground be moist. If the plants are set by hand, one person distributes the plants at the proper distance along the rows, followed by a man or boy who, with a round stick, makes a hole for the plants. A third person sets the plants in the holes and presses the soil firmly about the roots, leaving the surface of the soil as loose as possible. As the plants are set in the holes, a cupful of water should be poured into the holes, and some growers prefer to add water to the plants directly after they are set, although this practice leaves the soil about the plants in such condition as to bake, especially during a hot, dry day.

The object of the cultivation of the field is to keep the soil in as good condition as possible and to prevent the growth of weeds and the loss of soil moisture. In most cases a loose mulch should be maintained by frequent, shallow, level cultivation. As the plants grow, the soil should be stirred with a hoe around the plants. One of the best cultivators is called the Prout hoe, which is adjustable to the width of the rows, the small shovels leaving the surface with a fine even texture.

The topping process is necessary in order to direct the strength of the plant into the development of the leaves. After topping, the surface of the leaves very rapidly increases, the leaves thicken, and the ripening processes are hastened. The Broadleaf plants are usually topped below the first large sucker. If it is found desirable to hasten the ripening process, the plants are topped low, while if necessary to prevent the development of too thick leaves the plants should be topped high. Usually the topping process is delayed until most of the flower buds appear, so that the topping can all be done in one operation, but many growers prefer to remove the buds as soon as they appear, going over the field later and topping to the desired height. As soon as the suckers appear they should be broken off, and in order to do this effectively it is necessary to go over the field once a week after the plants have been topped.

The time to harvest the crop can only be determined by experience with the strain which is grown. As a rule, a ripe leaf has a rough feeling to the touch, and there is a change in the color of the leaf from a dark to a lighter green; also, by folding the leaf between the fingers a ripe leaf will break easily. In the Broadleaf variety the plants are usually cut, and as all the leaves on a plant are not ripe at one time, it is necessary to harvest the crop when the majority of the leaves are in the proper condition or about the time that the middle leaves are ripe. Overripe leaves lose their elasticity and strength, and are not suitable for cigar wrappers. The plants are speared on 4-foot laths, using a detachable iron spearhead fitted in the end of the lath, as shown in Plate V, figure 1, placing from 4 to 6 plants on each lath.

The Broadleaf tobacco is air cured, the process taking about six weeks. After harvesting, the plants are immediately hung in the barn, and the temperature and humidity of these sheds must be closely watched and controlled by means of the ventilators. If the leaf cures too rapidly the ventilators should be opened on moist days and nights and closed on dry days. If the curing process proceeds too slowly or the tobacco is liable to injury from pole-burn or other fungous diseases, the ventilators should be opened on dry days and closed on moist days and at night. In long-continued damp spells of weather, when the tobacco can not be dried out by opening the ventilators during the day, small fires of soft pine or charcoal should be used to drive off the excess of moisture and raise the temperature in the barns.

The Broadleaf tobacco is usually fermented in cases holding about three hundred pounds, the hands of tobacco being laid in these cases with the butts of the hands on the outside and the tips in the center. The tobacco is then pressed down under moderate pressure, the tops of the boxes screwed on, and the cases kept in a room having an even temperature.

CUBAN TOBACCO.

Cuban tobacco is grown without shade when used as a filler for domestic cigars. The percentage of wrappers in this outdoor crop is not large, but when the leaves are primed the percentage of wrappers is considerably increased. The preparation and care of the seed beds and methods of cultivation are about the same as in the case of the Sumatra variety. The rows in the field are arranged about 3 feet 4 inches apart and the plants set about 14 inches apart in the row. A greater distance results in thick, heavy leaves. If the plants are set too close the leaves are too thin and lacking in body for filler purposes.

No definite rule can be laid down as to the proper number of leaves to be left on the stalk when the plants are topped. This number varies with the height of the plant and the climatic conditions during the season. From 14 to 16 leaves, however, are considered desirable during the ordinary season. The suckers begin to appear very soon after topping and should be removed every 8 or 10 days or once a week when rains are frequent.

Worms are usually very troublesome on this variety of tobacco and must be picked off and destroyed as soon as they appear, or they can be poisoned with a very light spray of Paris green mixture. The "powder gun" has come into general use and is rapidly replacing the spray pump for poisoning the hornworm and budworm. The growers who still employ the spray pump use 1 pound of Paris green and an equal quantity of quicklime to 100 gallons of water, this being sufficiently strong to kill the hornworms without injuring the leaves. If a stronger solution is used there is danger of burning the leaves, so that patches of green will appear after curing. A mixture of 1 pound of Paris green to 30 pounds of lime or land plaster is recommended for use in the powder gun.

The manner of harvesting the southern Cuban tobacco is essentially the same as that practiced with the Connecticut Havana Seed tobacco. The number of plants to the lath, however, may be increased to 8 or 10, where the growth is comparatively small.

Some growers prefer to prime the Cuban tobacco. This process is more expensive, but a thinner leaf is obtained, which makes it possible to use a certain percentage of leaves for wrapper purposes. There are no advantages in this system over the present method of cutting the plants so far as the production of a filler leaf is concerned.

Where the soil has been abundantly fertilized and the season is favorable, a profitable second crop of filler can be grown, which is commonly called a "sucker crop." A week after cutting, all the suckers should be broken off the old stump with the exception of one, which is to be allowed to remain and mature. It should be handled in exactly the same way as the original crop. The sucker crop ordinarily produces about one-half the yield of the main crop. Insects are always very much worse late in the season and become very troublesome in the sucker crop.

ZIMMER SPANISH AND LITTLE DUTCH TOBACCOS.

The preparation and care of the seed bed for Zimmer Spanish and Little Dutch varieties should be the same as given for Connecticut Havana tobacco. The preparation of the soil and the methods of transplanting and cultivating are the same as those given for Connecticut Havana. The plants should be set in rows 3 feet apart and the seedlings set from 15 to 20 inches apart in the rows. The plants should be topped so as to leave about 16 leaves for each plant. The average yield of the Zimmer Spanish variety is about 600 pounds to the acre, while the yield of the Little Dutch variety is considerably less. The methods of harvesting, curing, and fermenting are essentially the same as those for the Connecticut Havana variety.

MARYLAND SMOKING TOBACCO.

The seed bed should be located on a dark, friable, loamy soil with a southern exposure. The plants may be easily watered if the seed bed be located near a brook. The old method of burning the seed bed has been largely abandoned, but, if used, care should be taken to burn only small timber and brush. A large quantity of ashes is detrimental to the growth of the young plants. All trees within 30 or 35 feet should be cut down and piled on the north and west sides of the seed bed for a partial protection against the cold winds.

The proper time for preparing and sowing the seed bed is from February 1 to March 30. The bed should be spaded to a depth of 4 or 5 inches, and all roots and tufts carefully removed. The soil must be thoroughly pulverized with garden hoes, hand rakes, or other suitable implements. Before the last stirring an application of a highly nitrogenous fertilizer should be evenly distributed over the bed and thoroughly incorporated into the soil. A mixture of 50 pounds of nitrate of soda, 40 pounds of fine-ground bone, and 10 pounds of carbonate of potash, applied at the rate of 30 pounds per square rod, is highly recommended.

Sow the seed at the rate of two tablespoonfuls to the square rod. It can best be uniformly distributed over the bed by mixing with wood ashes or land plaster, dividing it into two equal parts, and sowing half of it over the bed crosswise and the other half lengthwise. The sides of the bed should be from 8 to 10 inches high, and wires 3 feet apart should be stretched across it. The beds can be covered with light cheese cloth or tobacco-bed cloth, after the seed has been sowed. The covering serves as a protection against the ravages of the flea-beetles and other insects, provided there are no open spaces around the bed. All weeds and grass should be removed. It is seldom necessary to water the plant beds, except in the case of unusually dry weather. Water at this time is very essential. It should be applied as in the northern seed beds, but less frequently, it being seldom necessary to water the beds more than twice a week.

In most cases it is advisable to replenish the plant food with a top-dressing or fertilizer of the same composition as that of the first application. This should be applied in liquid form, wherever it is possible to wash it in thoroughly; otherwise it is most important to top-dress the beds only during hot, dry days. The top-dressing should be used when the plants are from 2 to 3 inches high. Where cloth is not used for a covering, the beds must be closely guarded against the attacks of the flea-beetle. When this insect first makes its appearance the plants should be treated with Paris green at the rate of 1 pound to 30 pounds of land plaster. The cloth covering should be removed from the beds at least a week before transplanting to prevent the injurious effect of the radical change from the seed bed to the open field.

Maryland tobacco is transplanted from May 15 to June 15. Care must be used to wet the seed bed down thoroughly before drawing the plants, thus protecting the roots from injury. The mottled or mosaic tobacco, so common in Maryland tobacco fields, is frequently due to the practice of drawing the plants when the soil is not thoroughly moistened. This variety should be set in the field in rows 3½ feet apart and the plants 20 to 35 inches apart in the row.

Tobacco should be preceded by a leguminous crop of some kind, hairy vetch being highly recommended for this purpose. In addition to the nitrogen from the leguminous crop a fertilizer rich in potash and containing a moderate amount of phosphoric acid should be added before transplanting. The best stand is obtained in the field where the land has been plowed deeply and harrowed several times, thus leaving a thoroughly pulverized soil for the reception of the plants. The methods of cultivation, topping, suckering, and harvesting are essentially the same as in the case of the Connecticut Havana variety.

NORTH CAROLINA, TENNESSEE, AND VIRGINIA TOBACCOS.

The methods of sowing the seed and of preparing and caring for the seed bed are the same in the case of North Carolina, Tennessee, and Virginia tobaccos as those used by the Maryland growers. The seed, however, may be sown at least a month earlier than in Maryland.

Two systems of harvesting are in general use, both of which have certain advantages. One of these systems is to prime the leaves as fast as they ripen and string them on laths, allowing 30 to 32 leaves to a lath. The other and more common system is to cut the entire stalk and cure the leaves on it, as is done with the Connecticut Havana variety.

The North Carolina, Tennessee, and Virginia tobaccos are usually flue cured or fire cured, for which purpose a special type of barn is used. The essential points of this barn are that it be practically air-tight and provided with one or two furnaces having flues leading up through the center of the barn, giving a large heating surface. There should be at least two small ventilators on or near the top of the barn.

As soon as the barn is filled with tobacco, fires should be started and the temperature raised to 90° F., where it should remain from 24 to 30 hours, during which time the tobacco becomes a uniformly bright yellow. The next step in curing is to raise the temperature from 90° to 120° F. for 15 to 20 hours. This process is commonly known as "fixing the color." Then the temperature may be increased gradually to 125° F., at which point it should be maintained for about 48 hours. By this time the leaves should be almost, if not entirely, yellow, but the stalk will still be green. In order to cure out the stalk, the temperature can be raised to 175° F., at the rate of 5 degrees an hour, where it should remain until the stalks are thoroughly dried. Great care must be taken during the entire process of curing not to allow the temperature to fall, for a lowering of the temperature during the process of curing invariably produces discolorations in some parts of the leaf.

WHITE BURLEY TOBACCO.

The seed bed should have a slightly southern exposure in order to get the benefit of the warm rays of the sun in the early spring, and the beds should be protected from cold winds. The best soil for the White Burley tobacco is a rich, friable, virgin loam or sandy soil. The best plan is to burn and prepare the seed bed on old sod lands. Many farmers select a spot in a vegetable garden and cover it with virgin mold taken from the woods, and sow it, after thoroughly burning the land until it has a reddish or brick-like appearance, when it should be spaded up and thoroughly chopped over with hoes until it is fine and even. The ashes should not be raked off, but should be thoroughly mixed in with the soil. As soon as the ground can be worked in the spring, it should be lightly spaded and thoroughly loosened to a depth of 2 or 3 inches with harrows or hand rakes. When in good condition, it should be marked off in beds about 4 or 5 feet wide and seeded. It is the usual custom with this variety to use a heaping tablespoonful of seed for every 100 square yards of seed bed. After sowing, the best plan is to run a heavy hand roller over the bed or press it with a board or with the feet. As a rule, the bed is tramped over with the feet until the surface is packed. The seed bed is usually protected by a canvas covering to prevent the ravages of flea-beetles and to keep the bed moist and warm.

The preparation of the land is generally begun in the month of March, the usual plan being to turn under the soil with a 2-horse plow to a depth of about 8 inches. About the middle of April a revolving disk or harrow is run over the land in order to cut the sod to pieces, after which the field is smoothed over with a slab drag. It is very rare for fertilizers or manure of any kind to be used in the White Burley districts. Tobacco stalks and trash from the barnyard are preferred to any other fertilizer for this tobacco. Owing to the fact that the crop is grown for two years and the field is then put in rotation with other crops, the fertility of the soil is maintained.

The tobacco plants are usually set after a shower, or when there is no rain they are set out in the afternoon. The land is cultivated with a bull-tongue cultivator during the first week or so, and then cultivated every week with a double-shovel cultivator as long as it is possible to do so without injury to the plants. As soon as the cultivation is finished the plants are topped, leaving from 16 to 20 leaves on each plant. From four to five weeks after topping, the tobacco is usually fully ripe and the plants are cut with a tobacco cutter or butcher knife. The stalks are split down the middle and strung on sticks 4½ feet in length, after which they are taken to the tobacco barn and hung 12 inches apart on the tier poles. When fully cured, the tobacco is sorted, usually into six grades, and the different grades are tied into bundles of from 10 to 20 leaves and packed for the market.

INSECT ENEMIES.

The general subjects of the insect enemies of tobacco and the use of insecticides are considered in Farmers' Bulletin No. 120, entitled "The Principal Insects Affecting the Tobacco Plant," which may be had without cost upon application to the Secretary of Agriculture. In case the seed beds are inclosed or covered, the tobacco is largely exempt from injury by such pests as flea-beetles and hornworms. The tobacco stalk weevil and tobacco thrips are comparatively new as pests. Two accounts of the former have been published and a detailed account of the latter is about to be issued by the Bureau of Entomology, to which office tobacco growers are referred for specific information in regard to methods of controlling insect pests. In the case of arsenicals it is always desirable to use at least an equal quantity of quicklime to prevent injury by free arsenic.

DIRECTIONS FOR SAVING SEED.

In all cases where new seed is taken into a locality it should be thoroughly tested before growing on a large scale. This is especially true of all seed imported from Cuba, Sumatra, Turkey, or other foreign countries. The past few years have witnessed a striking illustration of the effect of using seed direct from tropical regions, such as Cuba and Sumatra, when grown in the northern tobacco districts. The plants grown from this freshly imported seed broke up into many different types, some of which may prove valuable, but most of the types are irregular and undesirable. Therefore it has been a common experience for growers to suffer great losses by reason of the presence of these undesirable types during every season in which the seed was used. This breaking up of type is due to the effect of the change of soil and climatic conditions, resulting in striking variation in the plants grown from the imported seed. The variation is particularly marked where southern seed is taken to northern tobacco districts.

Our experiments have shown that if the seeds from typical and desirable plants in these crops are saved under bag, and thus protected from cross-fertilization, the plants produced from such seed will be uniformly like the parent plants. The uniformity of plants from seed saved under bag is illustrated in Plate IX, figure 1. The two rows shown in this illustration are from the seed of two plants of different types and all of the progeny are like the parents. The second season it is a good plan to increase the area of plants grown from seed saved under bag, and from the most desirable plants in this crop selections of seed can be made for future general crops. If the crop during the second season shows uniformity of a desirable type, it is advisable to save a large quantity of seed under bag—if possible, sufficient to plant several succeeding crops—in order to provide for a possible failure of seed production in future seasons. Inasmuch as tobacco seed when properly cared for will retain its vitality for from 10 to 20 years, this seed can be safely used, if necessary, for 5 years. The best practice, however, is to save the seed for the following year's crop every season unless some accident should greatly injure the crop.

The grower of all new varieties of seed should test them on a small area before using them for his entire crop. In some cases new seed, when grown under conditions different from those under which the seed was produced, develops plants which are subject to fungous diseases or insect enemies in the new conditions. Therefore it is a wise plan to grow a small area of tobacco the first season and observe the plants carefully in respect to the presence of fungous or other diseases before using them in large fields. In other cases certain fungous diseases are present in the soil, which attack and destroy the varieties imported from other regions. In most cases resistant plants can be found in fields affected by these diseases. The structure or habit of growth of these resistant plants is such as to make them immune to these attacks. The seed of resistant plants should be saved under bag and used for the next year's planting. In this way resistant strains of tobacco which will prove to be immune to the attacks of the various diseases may be secured.

In selecting seed plants several important facts should be taken into consideration. All the plants in the field should be carefully studied and observations made on the shape of the leaf of the different plants, on the variations in size and color of leaves, and on the time of maturity of individual plants in the field.

Plate VIII, figure 2, shows two strains of Connecticut Broadleaf, the larger one from an early parent and the other from a late parent. The number of leaves and the number of suckers should be counted on many plants in the field from which seed is to be saved, in order that an accurate idea may be gained of the extent of variation in the variety as regards these points. As a rule, there is a great variation in all of the important characters which go to make up the type of plants, and individual plants will be found which have desirable shape, size, and color of leaf, which mature early and have an extra large number of leaves and few suckers. The grower should decide in his own mind on the type of plant which he desires to grow for his crop and should carefully select those plants in the field which most nearly fulfill this ideal.

The flower head on the selected seed plants should be inclosed with a light but strong paper bag just before the flowers begin to open. The proper time to apply the bag is shown in Plate VII, figure 1, and the arrangement of bags is shown in Plate VII, figure 2. It is usually a good plan to remove two or three of the top leaves and suckers just below the flower head. The bag should be tied around the stem in such a way as not to interfere with the growth. It will be found that at this period of growth the plant increases in height very rapidly, and it will be necessary to raise the bag occasionally in order to prevent the flower head from pushing out through the bottom of the bag. For most varieties a 12-pound bag is the most desirable size. This bag should be of strong but light material. The ordinary paper bag found at any grocery store may be satisfactory for this purpose.

When the seed pods have turned brown, indicating maturity, the entire top of the plant should be cut off. The bag should be opened and all of the small and late pods picked off and only the large, heavy, plump, and well-developed seed pods allowed to remain. The bag should then be replaced and the seed head hung up in a dry place where there is a free circulation of air, such as the attic of a house, until the seed pods are thoroughly dried. After this the pods should be picked off from the stem and the seed shelled out. After the seed has been secured, all of the light seed, hulls, and chaff should be removed by the use of a seed separator, as shown in Plate IV, figure 1, or by some form of air-blast machine adapted for this purpose, and only the heavy seed should be retained for planting. The heavy seed should then be placed in dry glass jars and set in a safe place. In this condition the seed will retain its vitality unimpaired for a long period.

In many cases it may be desired to cross an imported with a native variety. The object of such crosses is to secure the improved quality of the imported strains, combined with the hardiness and yielding power of the native varieties. In the case of tobacco such crosses are easily made by the grower. The tobacco plant has a perfectly self-fertile and complete flower, but is easily cross-fertilized. In order to prepare the flower for cross-fertilization, the anthers should be removed from the selected flowers shortly before they open and discharge their pollen. The arrangement of the parts of the tobacco flower at different stages of maturity is shown in Plate VIII, figure 1. The opened flower in the lower right-hand corner shows the proper stage for the removal of the anthers. After an examination of a number of flowers in the field the grower can easily observe the proper time to remove the anthers so that none of the pollen shall have escaped and fertilized the flower. One easy means of noting this time is to observe the condition of the corolla. The anthers should be removed just before the corolla opens. As soon as the anthers have been removed, a small paper bag should be tied over the flower and allowed to remain for at least one day or until the stigma becomes receptive for pollen. This receptive condition of the stigma is easily noted by the presence of a sticky, viscid substance over the surface. At the proper time for pollination, anthers from the desired imported strain which are just ready to discharge their pollen should be secured. These anthers should be broken open and the pollen carefully rubbed over the surface of the stigma of the flower to be fertilized. As soon as this pollination has been completed, the small bag should be replaced over the flower and allowed to remain there until the end of the season. A small tag should be attached to the flower, giving the name of both parents, as Havana × Sumatra (the first name referring to the female and the second to the male parent), with any other data which would assist the grower in keeping a record of the parentage of the cross.

The best plan which can be followed in the case of crosses is to grow 100 plants of each cross and carefully note the characteristics of the hybrid plants. It will be found that there will be considerable variation in the plants the first season. Seed should be saved from those plants which are most desirable and which show the greatest improvement over the native varieties. The next season a larger area can be planted from this seed; and if the crop is uniformly of the type desired, enough seed can then be selected the second season to plant the entire crop the third year.

HOW TO SECURE GOOD SEED.

1. Save the best plants in the field for seed plants. An early Broadleaf plant of desirable type is shown in Plate VIII, figure 2, in comparison with the ordinary plants, and was selected for seed production on account of earliness. During the cultivation of the crop and the suckering and topping processes a constant search for good plants should be made by growers.

2. When good plants are observed, they should be plainly marked by a tag or rag tied to the plant, so that they may be easily found and to prevent them from being accidentally topped.

3. Place a light, 12-pound size, manila paper bag over the flower heads of the selected seed plants before the first flowers open. Inspect the bags every few days for the first two weeks and raise them up farther on the growing stems, arranging them so as to prevent any injury from crowding in the bag during this period of growth. The extent to which this method of saving seed is now being followed is shown in Plate VI, figure 1.

4. At the end of the season, when the seed pods are ripe, cut off the plants near the ground without removing the bags and hang them up in a dry place. The bags serve to catch the seed which may fall out of the capsules on drying.

5. After the seed has thoroughly dried, shell it out of the capsules and separate the heavy seed for use by the means described in this paper.

6. It would be well for every grower using this method of seed selection to save some seed in the ordinary way and plant it for comparison.

PLATES.

DESCRIPTION OF PLATES.

Plate I. (*Frontispiece.*) Fig. 1.—Connecticut Cuban tobacco, first year from Cuba. Plants in foreground are freaks and undesirable. They have reached maturity prematurely, and have very few salable leaves. The suckers and flower branches are numerous and large. Fig. 2.—The same field shown in figure 1, after saving seed under bag and the selection of the best plants for two years. These plants have a large number of well developed, desirable leaves, with very few suckers or seed branches, as the result of careful seed selection.

Plate II. Fig. 1.—Tobacco seed bed in Florida. This illustration shows plants just before transplanting. Note the uniformity of those grown from heavy seed. The bed, covering 2 acres, furnished enough plants for more than 100 acres of tobacco. Fig. 2.—Tobacco seed beds in Connecticut—tent, hotbed, and cold frame. The three best methods used for protecting tobacco seedlings in the North are shown. The beds in the center of the picture are covered with hotbed sash; the one on the right with cheese cloth raised about 12 inches above the surface of the bed; the one on the left is also covered with cheese cloth, arranged in the shape of a roof or tent and elevated sufficiently to allow workmen to walk about the bed without removing the cover. The glass covering seems to give the best results in most cases, and is conducive to the most rapid growth.

Plate III. Fig. 1.—Transplanting tobacco seedlings with machine. The most satisfactory and practical transplanter is shown. By using this form of machine the seedlings may be set in the field whenever they are of the proper size, and easily watered. Fig. 2.—Sterilizing soil for tobacco seed beds. This method is cheap and effective, and serves to kill all weed seeds, fungi, and insects that may be in the soil.

Plate IV. Fig. 1.—Tobacco seed separator. This form of separator is an improvement over the one originally devised in the Laboratory of Plant Breeding of the Bureau of Plant Industry, and described in the Yearbook of the Department of Agriculture for 1904. Fig. 2.—Seedlings from heavy, medium, and light tobacco seed. The seed from which the seedlings shown were grown was taken from the same lot and planted at exactly the same time. Note the increased growth and vigor in plants grown from heavy seed.

Plate V. Fig. 1.—Method of "spearing" tobacco plants during harvest. This shows the most practical and economical means of spearing plants with the least possible injury to the leaves. The plants are allowed to wilt very slightly before spearing. Fig. 2.—Wagon rack for transporting plants to curing shed. The group of seed plants in the background shows lack of selection under the old practice.

Plate VI. Fig. 1.—Capped plants saved for seed. The ordinary manila paper bag of the 12-pound size was used in capping these plants. The bag should be made of a thin grade of paper. Fig. 2.—Curing shed in the Connecticut Valley. The superior value of this form of curing shed is largely due to the large number of ventilators which may be opened to admit air when needed in properly curing tobacco.

Plate VII. Fig. 1.—Seed plant ready for bag. In preparing the seed plant for bagging, as shown, the small leaves and suckers just below the seed head have been removed to make room for the bag. Fig. 2.—Proper arrangement of bag on seed plant. When the bag is placed on the flower head of the seed plant, as shown, it should be tied rather loosely around the stalk, to allow for its proper development.

Plate VIII. Fig. 1.—Arrangement and structure of tobacco flowers. The structure of the flowers, as shown, gives evidence of the fact that tobacco flowers are naturally self-fertile. Fig. 2.—Two strains of Connecticut Broadleaf tobacco, the row on the left from an early parent and the row on the right from a late parent. The plant on the right of the center of the picture, from a late parent, is representative of the entire plat.

Plate IX. Fig. 1.—Uniformity in time of maturity and other characters of two types of Connecticut Sumatra tobacco raised from seed saved under bag. This striking uniformity is due to three years of careful seed selection and protecting the flowers from cross-pollination. Each row represents a different strain of the tobacco. Fig. 2.—Lack of uniformity in time of maturity and other characters in ordinary Connecticut Broadleaf tobacco, where seed was not saved under bag.

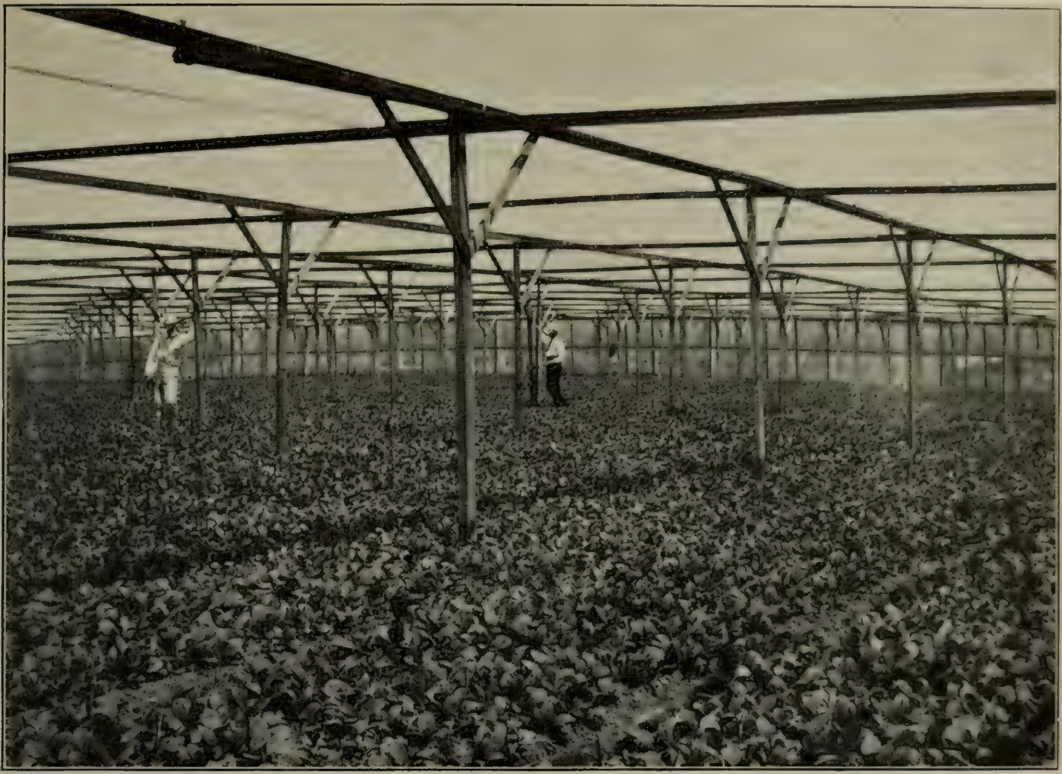


FIG. 1.—TOBACCO SEED BED IN FLORIDA.

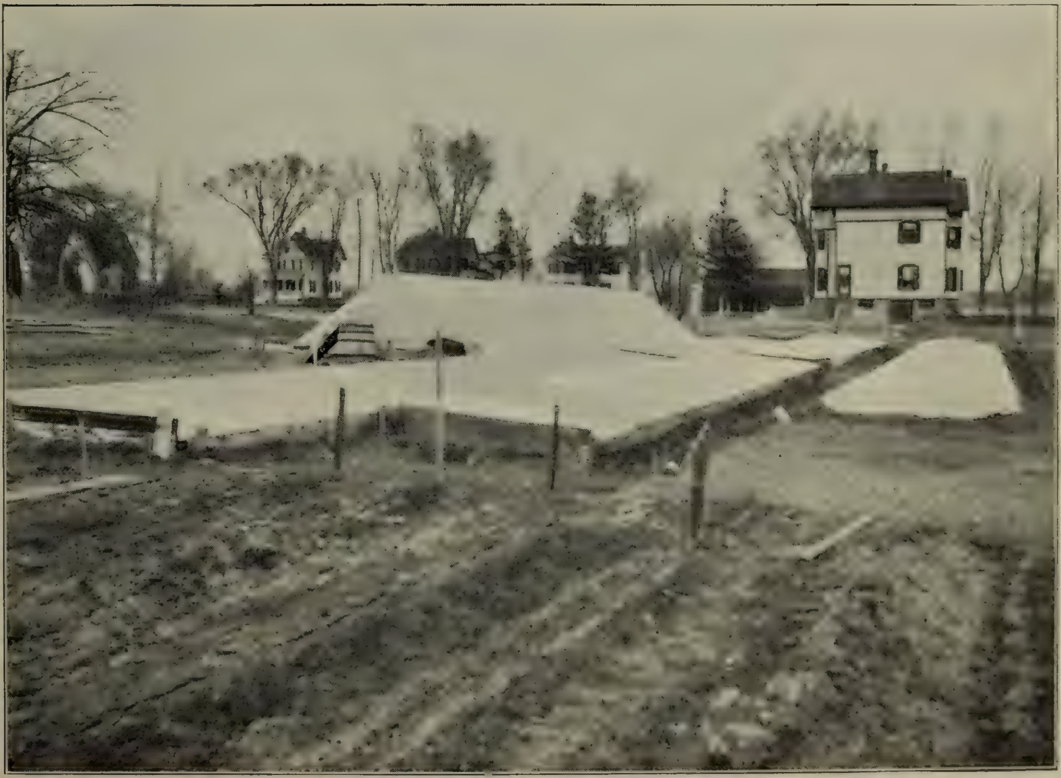


FIG. 2.—TOBACCO SEED BEDS IN CONNECTICUT—TENT, HOTBED, AND COLD FRAME.

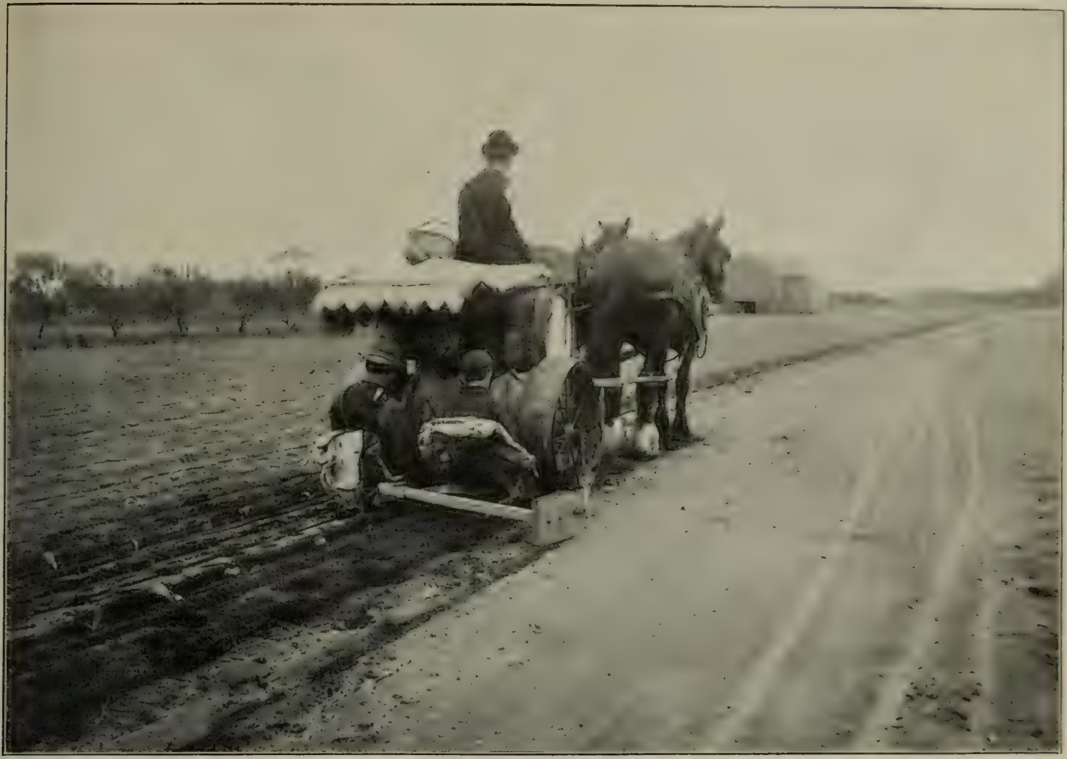


FIG. 1.—TRANSPLANTING TOBACCO SEEDLINGS WITH MACHINE.

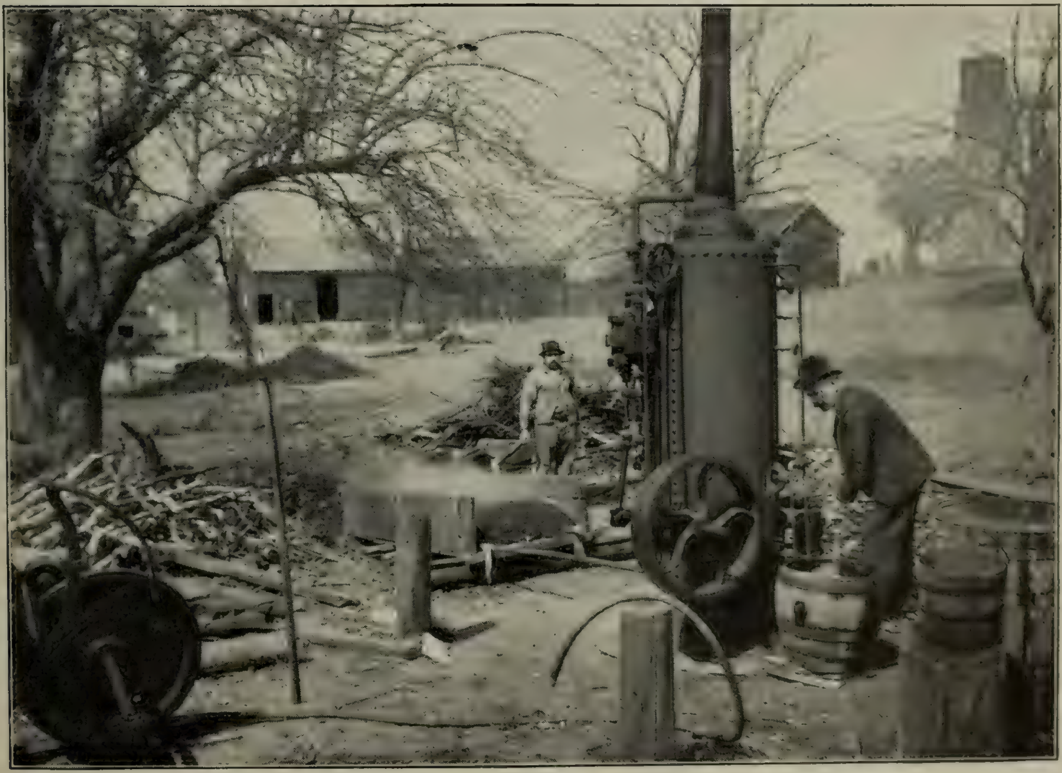


FIG. 2.—STERILIZING SOIL FOR TOBACCO SEED BEDS.

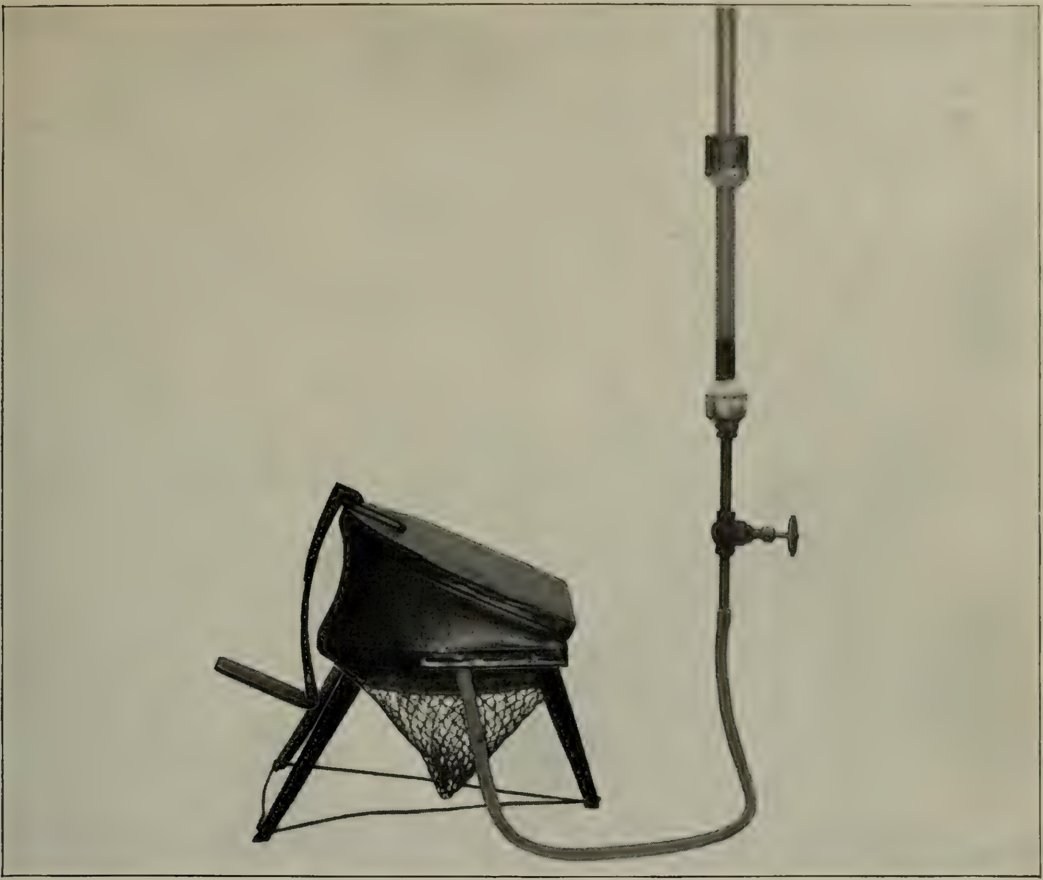


FIG. 1.—TOBACCO SEED SEPARATOR.

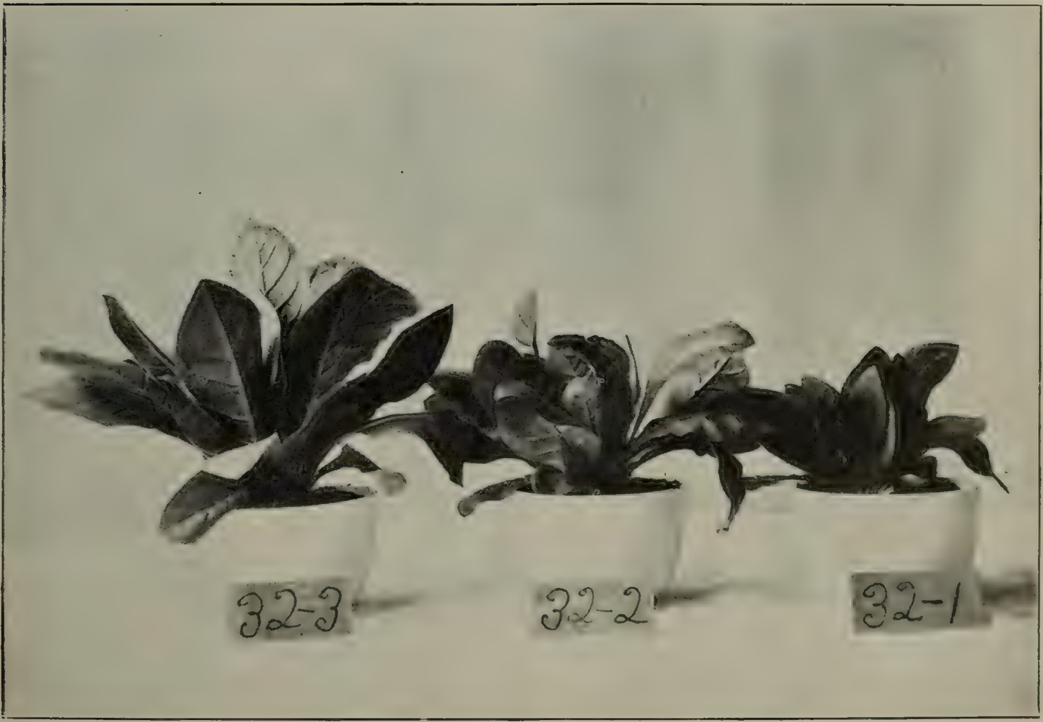


FIG. 2.—SEEDLINGS FROM HEAVY (32-3), MEDIUM (32-2), AND LIGHT (32-1) TOBACCO SEED.

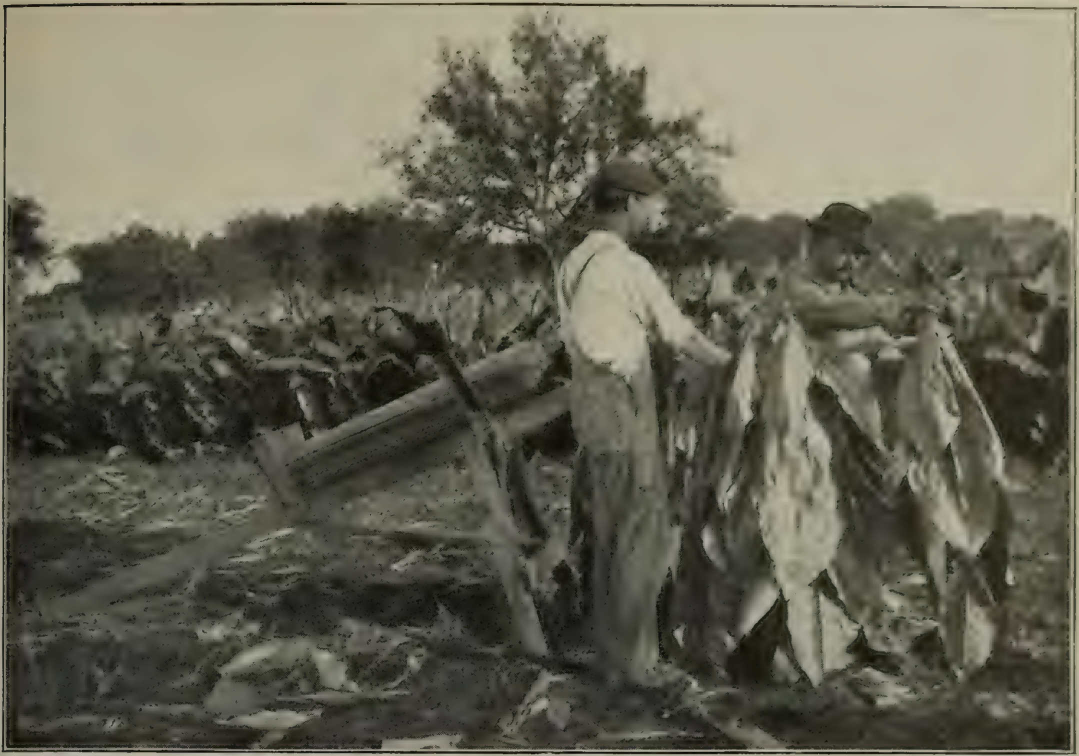


FIG. 1.—METHOD OF "SPEARING" TOBACCO PLANTS DURING HARVEST.

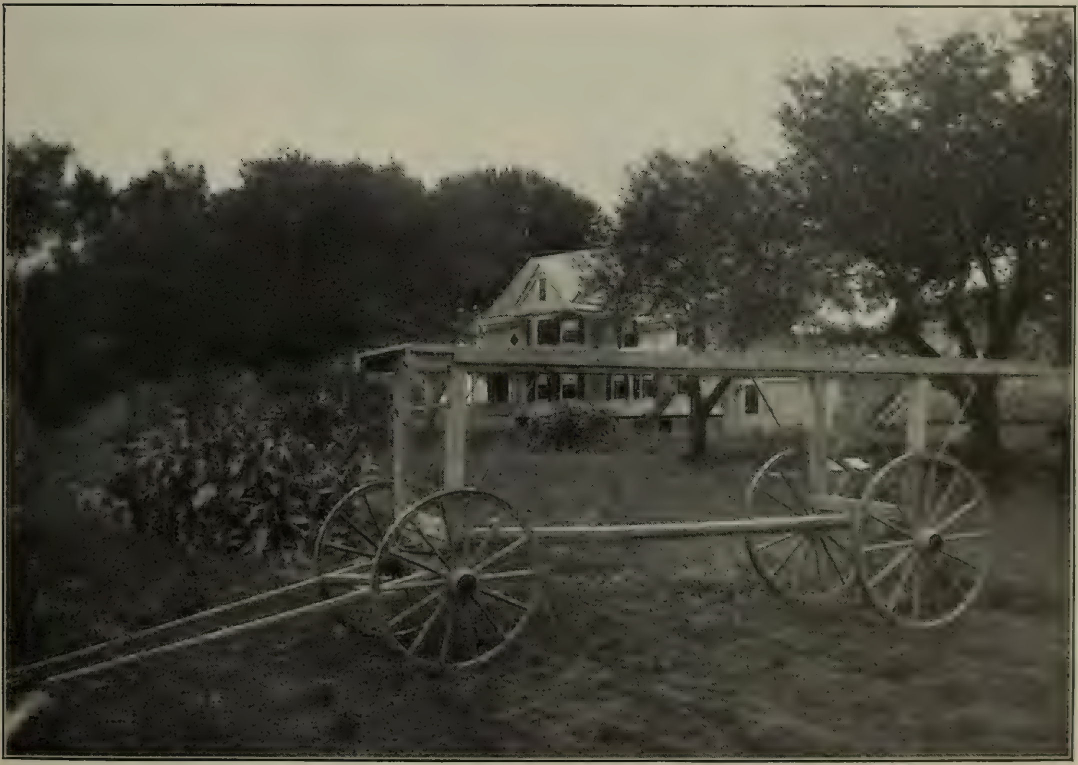


FIG. 2.—WAGON RACK FOR TRANSPORTING PLANTS TO CURING SHED.

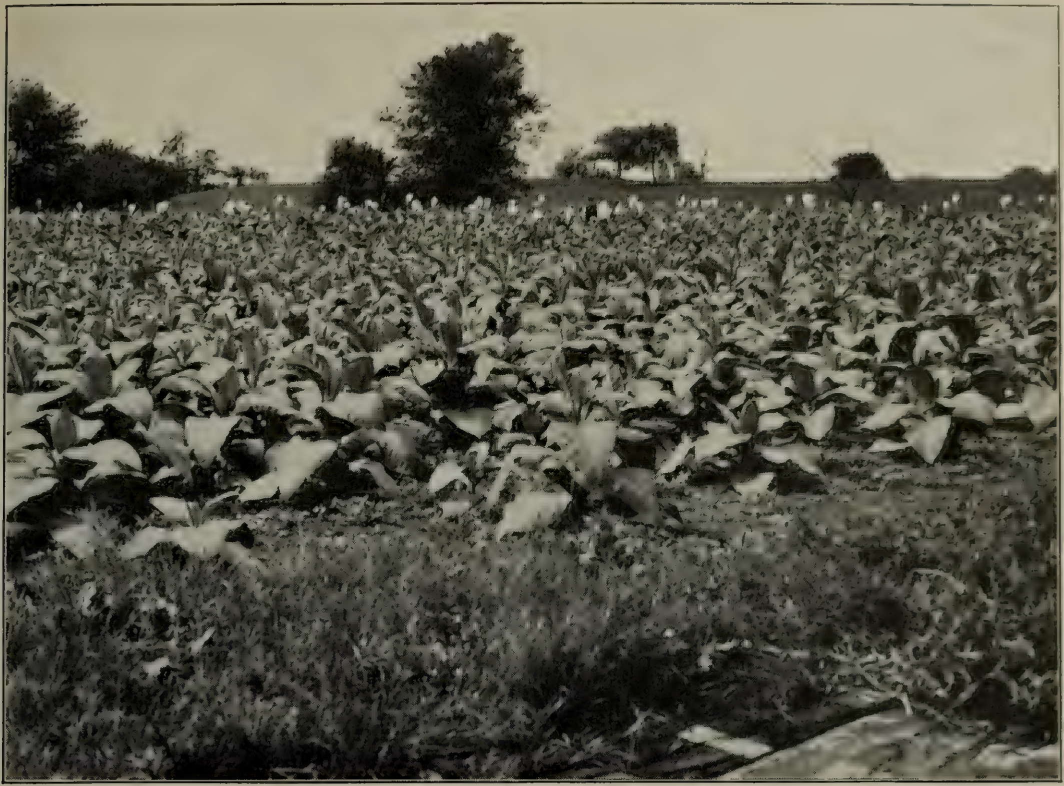


FIG. 1.—CAPPED PLANTS SAVED FOR SEED.

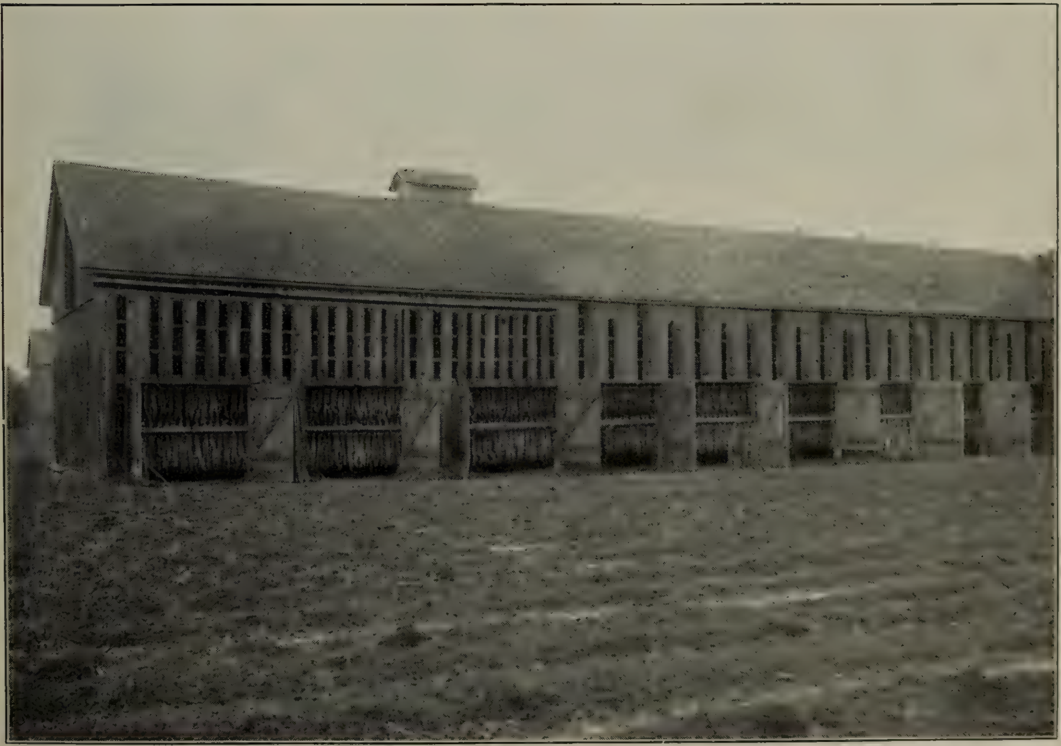


FIG. 2.—CURING SHED IN THE CONNECTICUT VALLEY.

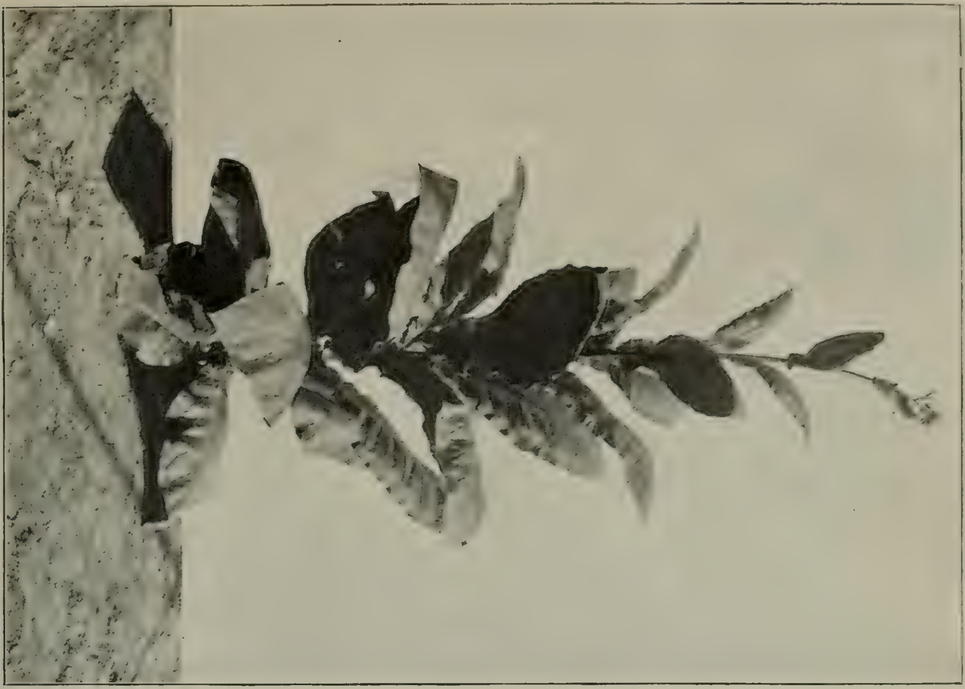


FIG. 1.—SEED PLANT READY FOR BAG.

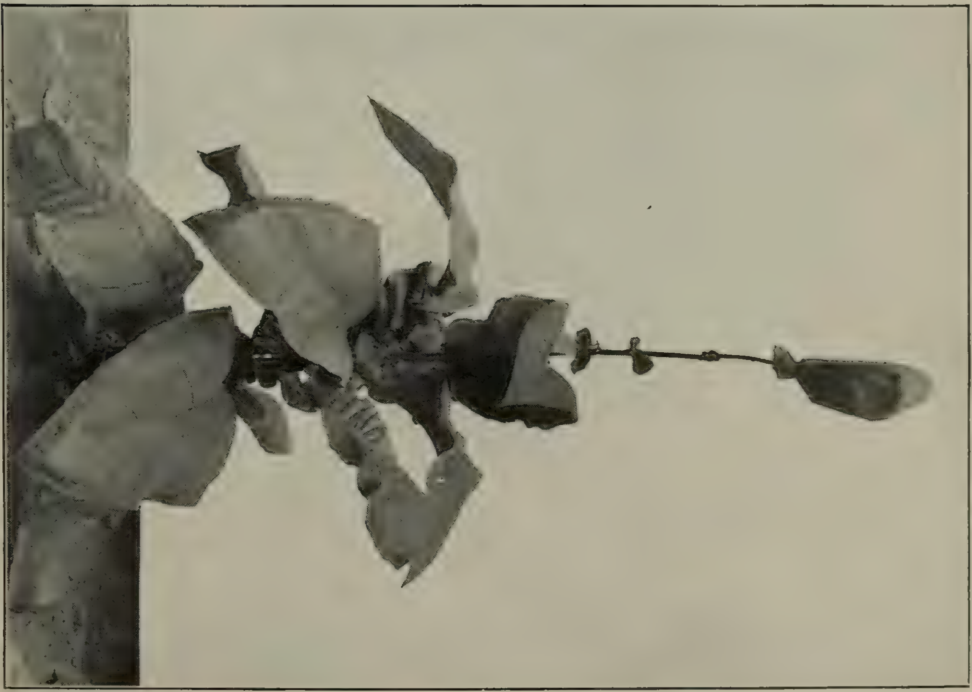


FIG. 2.—PROPER ARRANGEMENT OF BAG ON SEED PLANT.

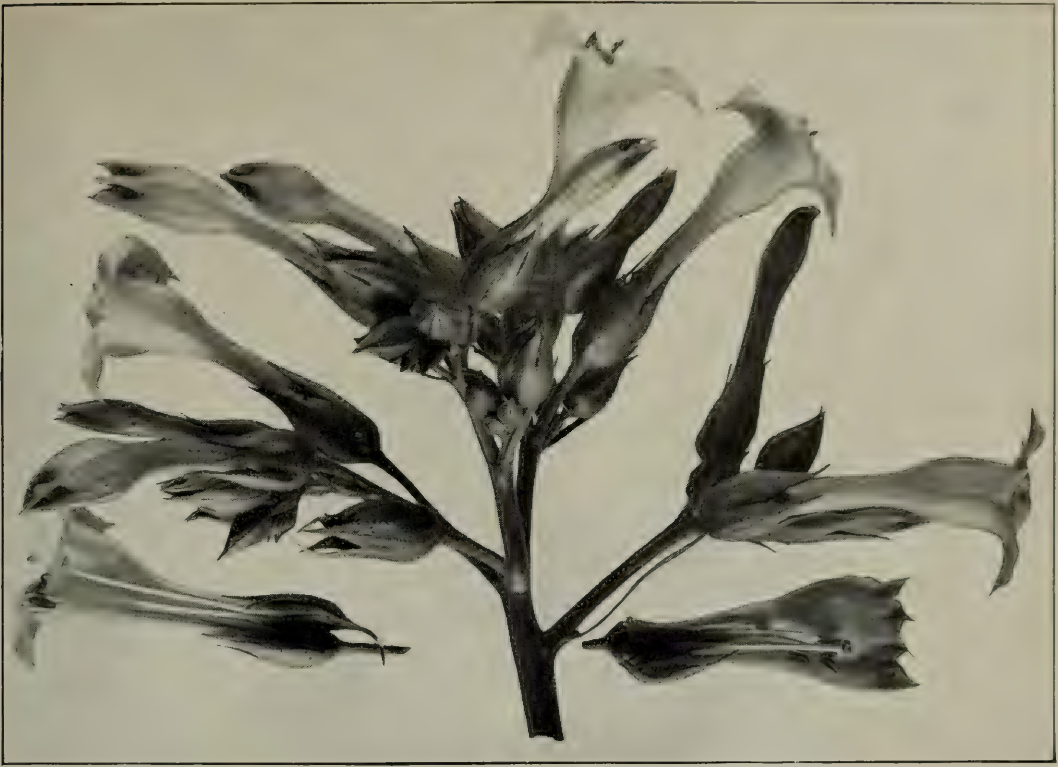


FIG. 1.—ARRANGEMENT AND STRUCTURE OF TOBACCO FLOWERS.

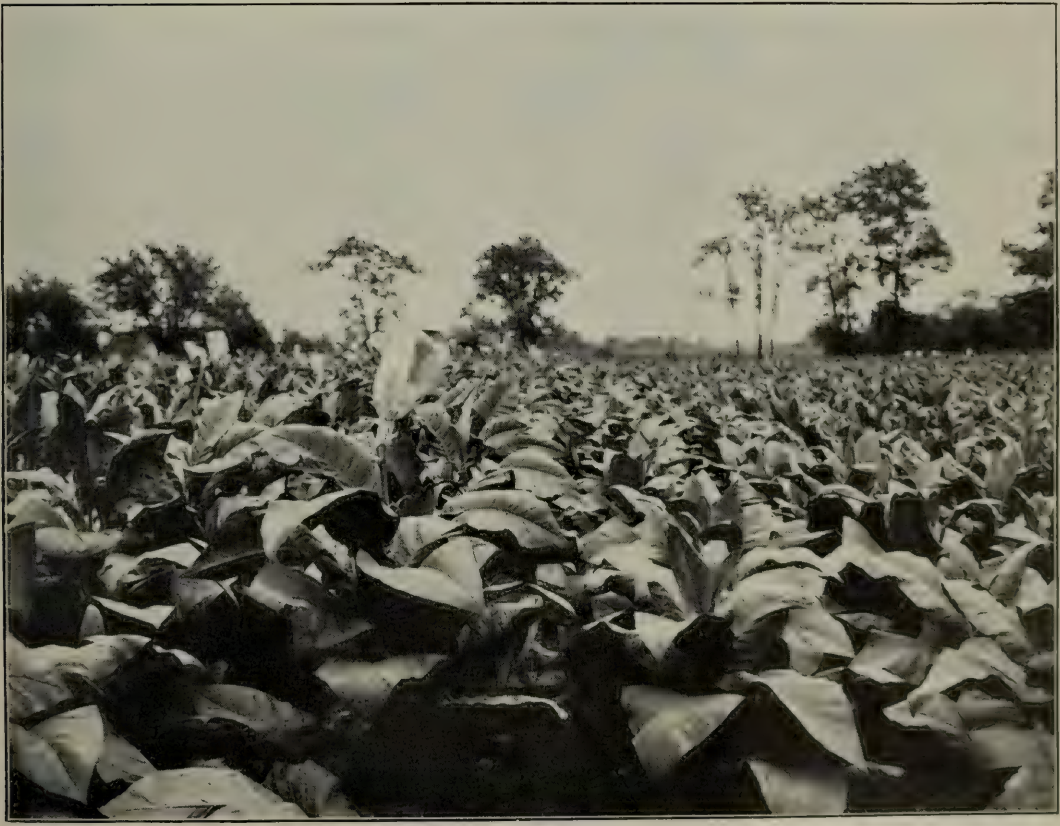


FIG. 2.—TWO STRAINS OF CONNECTICUT BROADLEAF TOBACCO; THE ROW ON THE LEFT FROM AN EARLY PARENT, AND THE ROW ON THE RIGHT FROM A LATE PARENT.

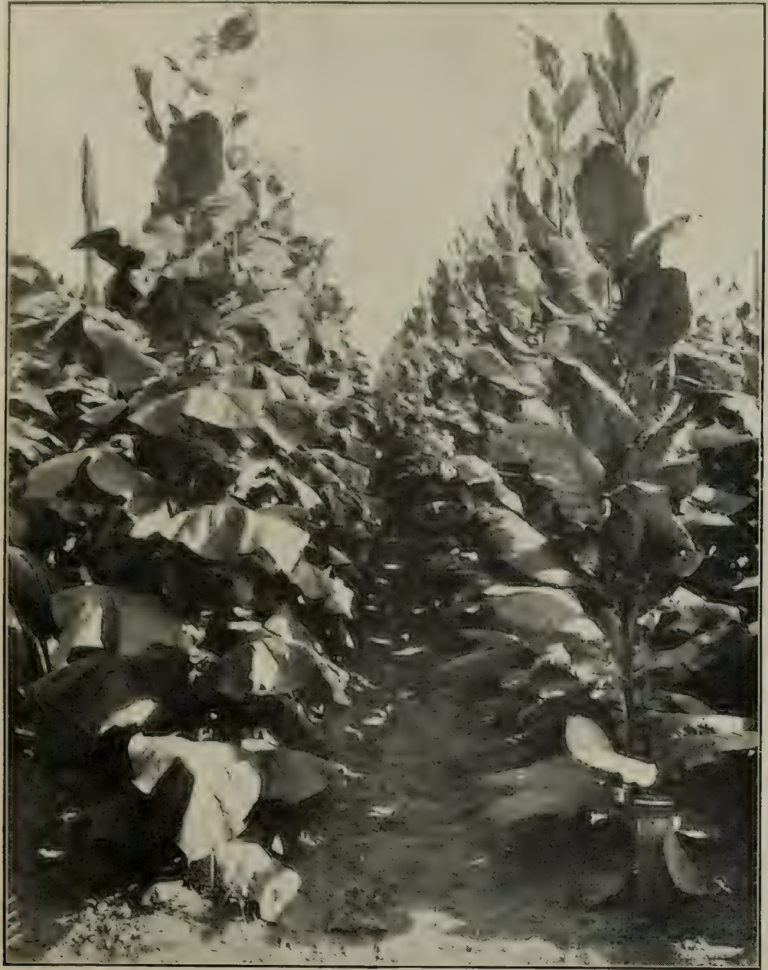


Fig. 1.—Uniformity in Time of Maturity and Other Characters of Two Types of Connecticut Sumatra Tobacco Raised from Seed Saved Under Bag.

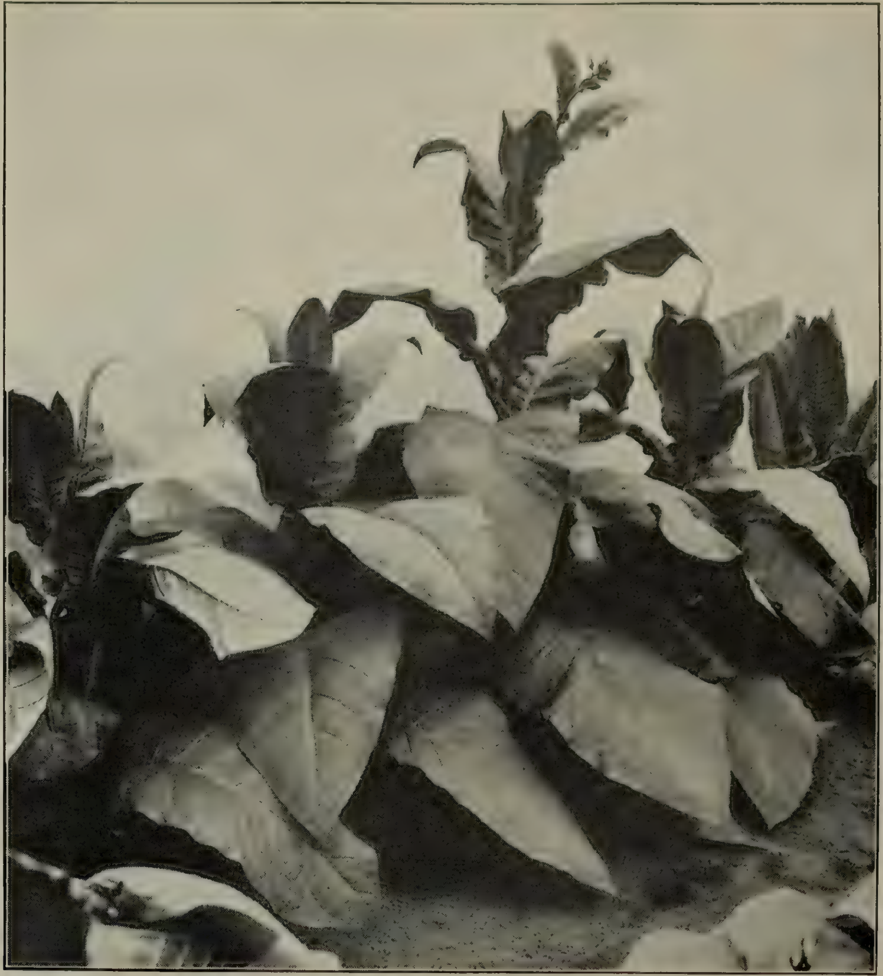


Fig. 2.—Lack of Uniformity in Time of Maturity and Other Characters in Ordinary Connecticut Broadleaf Tobacco.

HARVESTING DEGLET NOOR DATES AT TOZER.

(From a photograph by F. Soler, Tunis.)

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 92.

B. T. GALLOWAY, *Chief of Bureau.*

DATE VARIETIES AND DATE CULTURE IN TUNIS.

BY

THOMAS H. KEARNEY,
Physiologist, Plant Breeding Investigations.

Issued September 6, 1906.

1862 1889

239406
13. 1. 30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

BUREAU OF PLANT INDUSTRY.

SCIENTIFIC STAFF.

Pathologist and Physiologist, and Chief of Bureau, Beverly T. Galloway.
Pathologist and Physiologist, and Assistant Chief of Bureau, Albert F. Woods.

PATHOLOGICAL INVESTIGATIONS.

Laboratory of Plant Pathology, Erwin F. Smith, Pathologist in Charge.
Diseases of Fruits, Merton B. Waite, Pathologist in Charge.

PHYSIOLOGICAL INVESTIGATIONS.

Plant Breeding, Herbert J. Webber, Physiologist in Charge.
Plant Life History, Walter T. Swingle, Physiologist in Charge.
Soil Bacteriology and Water Purification, Karl F. Kellerman, Physiologist in Charge.
Bionomic Investigations of Tropical and Subtropical Plants, Orator F. Cook, Bionomist in Charge.
Drug and Poisonous Plant Investigations and Tea Culture Investigations, Rodney H. True, Physiologist in Charge.
Physical Laboratory, Lyman J. Briggs, Physicist in Charge.

TAXONOMIC INVESTIGATIONS.

Economic Collections, Frederick V. Coville, Botanist in Charge.

AGRONOMIC INVESTIGATIONS.

Farm Management, William J. Spillman, Agriculturist in Charge.
Grain Investigations, Mark A. Carleton, Cerealist in Charge.
Arlington Experimental Farm, Lee C. Corbett, Horticulturist in Charge.
Sugar-Beet Investigations, Charles O. Townsend, Pathologist in Charge.
Western Agricultural Extension, Carl S. Scofield, Agriculturist in Charge.
Dry Land Agriculture, E. Channing Chilcott, Expert in Charge.

HORTICULTURAL INVESTIGATIONS.

Pomological Collections, Gustavus B. Brackett, Pomologist in Charge.
Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge.
Experimental Gardens and Grounds, Edward M. Byrnes, Superintendent.

SEED AND PLANT INTRODUCTION INVESTIGATIONS.

Seed and Plant Introduction and Distribution, Adrian J. Pieters and David Fairchild, in Charge.
Seed Laboratory, Edgar Brown, Botanist in Charge.

SPECIAL LABORATORIES, GARDENS, AND FARMS.

Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge.
Subtropical Laboratory and Garden, Miami, Fla., Ernst A. Bessey, Pathologist in Charge.
Plant Introduction Gardens, Chico, Cal., Palemon H. Dorsett, Pathologist in Charge.
Cotton Culture Farms, Seaman A. Knapp, Lake Charles, La., Special Agent in Charge.

Editor, J. E. Rockwell.
Chief Clerk, James E. Jones.

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

SCIENTIFIC STAFF.

A. J. Pieters, *Botanist in Charge.*

David Fairchild, *Agricultural Explorer, in Charge of Foreign Explorations.*
W. W. Tracy, sr., *Superintendent of Testing Gardens.*
John E. W. Tracy, *Assistant Superintendent of Testing Gardens, in Charge of Congressional Seed Distribution.*
O. W. Barrett, *Assistant.*
George W. Oliver, *Expert.*
C. V. Piper, *Agrostologist, in Charge of Forage-Crop Investigations.*
J. M. Westgate, *Assistant Agrostologist, in Charge of Alfalfa and Clover Introduction.*
W. W. Tracy, jr., *Assistant Botanist.*
Frank N. Meyer, *Agricultural Explorer.*
Charles F. Wheeler, *Expert.*
A. B. Connor, *Special Agent.*
Nickolas Schmitz, *Special Agent.*
John H. Tull, *Special Agent, in Charge of Matting-Rush Investigations.*
Harold T. Nielsen, *Scientific Assistant in Agronomy.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., March 1, 1906.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 92 of the series of this Bureau, the accompanying manuscript, entitled "Date Varieties and Date Culture in Tunis," by Thomas H. Kearney, Physiologist, Plant Breeding Investigations.

The importance of this bulletin lies in the fact that it presents a key to the principal varieties of date palms—the first available to Americans interested in this fruit. It gives, further, an accurate picture of the conditions under which profitable date culture is carried on in the northern edge of the Sahara, and can not fail to be of value to all prospective date growers.

Acknowledgment is made of the courteous cooperation uniformly extended to Mr. Kearney by the authorities during his stay in Tunis. The valuable assistance rendered him by M. Hugon, director of agriculture and commerce, and by MM. Chervin, Minangoin, and Tellier, of the direction of agriculture, as well as by the contrôleurs civils at Tozer, Gafsa, Sfax, and Gabes, and by the caids of Tozer and Kebili, should be especially mentioned. The hospitality extended by Captain Donau, commandant supérieur at Kebili, and the great service rendered by him to the Department of Agriculture in having collected, prepared, and forwarded to Tozer 175 offshoots of the best varieties found in the Nefzaoua, merit especial acknowledgment. Prof. Milton Whitney, Chief of the Bureau of Soils, and Drs. F. K. Cameron and L. J. Briggs, of that Bureau, obligingly cooperated in furnishing mechanical analyses of the soil samples collected and chemical analyses of the soil and water samples.

This paper has been submitted by the Botanist in Charge of Seed and Plant Introduction and Distribution, and was prepared as a result of Mr. Kearney's expedition to the oases of Tunis in search of new varieties of dates.

The illustrations which accompany this paper are considered essential to a full understanding of the text.

Respectfully,
B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

Page.

- Introduction 9
- Characteristics of the region 11
  - Geography 11
    - The Jerid 11
    - The Nefzaoua 17
    - Gabes 19
    - Gafsa 20
  - Climate 21
    - Temperature 21
    - Atmospheric humidity 26
    - Precipitation 27
  - Irrigation and drainage 28
    - Water supply 28
    - Irrigation system 31
    - Drainage system 33
  - Soils of the Jerid region 33
    - Texture 33
    - Fertility 35
    - Alkali 36
- Culture of the date palm 41
  - Size and value of the gardens 41
  - Labor and tenantry system 42
  - Propagation 43
  - Preparing the land 45
  - Planting 46
  - Irrigating 47
  - Manuring 49
  - Other cultural methods 50
  - Pollination and male palms 50
  - Ripening 51
  - Harvesting 52
  - Preserving 54
- Varieties of the date palm in Tunis 55
  - Descriptions of the varieties 60
    - Varieties of primary importance 60
      - Soft dates 60
      - Dry dates 71
    - Varieties of secondary importance 74
      - Dry dates 74
      - Soft dates 76
    - Varieties of minor importance 82
      - Dry dates 82
      - Soft dates 84
    - Varieties imported but not included in the key 90
    - Varieties included in the key but not imported 92
  - Descriptive key to the characters of the fruits 94
    - Synopsis of the groups 96
    - Key to the varieties 97
- Index 107
- Description of plates 112

ILLUSTRATIONS.

PLATES.

Page.
PLATE I. Harvesting Deglet Noor dates at Tozer .... Frontispiece.
II. Fig. 1.—Alkali land in the midst of Tozer oasis. Fig. 2.—Working the soil of a date garden with the "messah," or short-handled hoe 112
III. Date palm showing "straddling" of fruit cluster to prevent the breaking of the stalk 112
IV. Fig. 1.—Tronja palm showing characteristic drooping, curved leaves. Fig. 2.—A typical male date palm showing numerous leaves 112
V. Fig. 1.—Menakher palm with numerous small suckers. Fig. 2.—Old Menakher palm with two large fruiting suckers 112
VI. Fig. 1.—Deglet Noor palm. Fig. 2.—Lagoo palm. Fig. 3.—The town of Nefta, with date garden in left foreground 112
VII. Fig. 1.—Fteemy palms, El Oudiane. Fig. 2.—Plantation of 6-year-old date palms at Nefta. A Fteemy palm in the foreground 112
VIII. Dates, natural size: 1, Deglet Noor variety; 2, Menakher variety 112
IX. Dates, natural size: 1, Tronja variety; 2, Boo Affar variety 112
X. Dates, natural size: 1, Horra variety; 2, Kenta variety; 3, Fteemy variety; 4, Mokh Begry variety 112

TEXT FIGURES.

FIG. 1. Map showing the location of the Tunis oases with respect to other localities in Algeria and Tunis 12
2. Irrigation canal and diversion dam, Tozer oasis 31
3. Laborer holding a "messah," or short-handled hoe 44
4. Date-picker holding a "mengel," or straight-bladed sickle, used for cutting off the bunches of dates 44
5. Camel carrying date offshoots wrapped in palm fiber (leef) for transportation 45
6. Outlines of Menakher seed and fruit. (Natural size) 61
7. Outlines of Deglet Noor seed and fruit. (Natural size) 63
8. Outlines of Boo Affar seed and fruit. (Natural size) 66
9. Outlines of Tronja seed and fruit. (Natural size) 67
10. Outlines of Boo Fagoos seed and fruit. (Natural size) 67
11. Tafazween seeds and fruits. (Natural size) 68
12. Outlines of Fteemy seed and fruit. (Natural size) 69
13. Outlines of Areshty seed and fruit. Natural size) 71
14. Outlines of Horra seed and fruit. (Natural size) 72

Page.
FIG. 15. Outlines of Kenta seed and fruit. (Natural size) 73
16. Outlines of Angoo seed and fruit. (Natural size) 74
17. Outlines of Thaby seed and fruit. (Natural size) 75
18. Outlines of Lemsy seed and fruit. (Natural size) 75
19. Outlines of Halooa Bayda seed and fruit. (Natural size) 76
20. Outlines of Mokh Begry seed and fruit. (Natural size) 76
21. Outlines of Baydh Hammam seed and fruit. (Natural size) 77
22. Outlines of Kseba seed and fruit. (Natural size) 77
23. Outlines of Doonga seed and fruit. (Natural size) 78
24. Outlines of Besser Haloo seed and fruit. (Natural size) 78
25. Outlines of Okht Fteemy seed and fruit. (Natural size) 79
26. Outlines of Rhars seed and fruit. (Natural size) 79
27. Outlines of Lagoo seed and fruit. (Natural size) 80
28. Outlines of Zekry seed and fruit. (Natural size) 81
29. Outlines of Khalt Mooashem seed and fruit. (Natural size) 81
30. Outlines of Khalt Deglaowia seed and fruit. (Natural size) 82
31. Outlines of Khalt Horraowia seed and fruit. (Natural size) 82
32. Outlines of Bayjoo seed and fruit. (Natural size) 83
33. Outlines of Remta seed and fruit. (Natural size) 83
34. Outlines of Hamra seed and fruit. (Natural size) 84
35. Outlines of Kenteeshy seed and fruit. (Natural size) 84
36. Outlines of Tantaboosht seed and fruit. (Natural size) 85
37. Outlines of Tozer Zaid Safra seed and fruit. (Natural size) 85
38. Outlines of Tozer Zaid Khala seed and fruit. (Natural size) 85
39. Outlines of Sayba Boo Dra seed and fruit. (Natural size) 86
40. Outlines of Kharooby seed and fruit. (Natural size) 86
41. Outlines of Gasby seed and fruit. (Natural size) 87
42. Outlines of Bent Segny seed and fruit. (Natural size) 87
43. Outlines of Ammary seed and fruit. (Natural size) 88
44. Outlines of Goondy seed and fruit. (Natural size) 88
45. Outlines of Karooy seed and fruit. (Natural size) 89
46. Outlines of Iteema seed and fruit. (Natural size) 89
47. Outlines of Khalt Hameed seed and fruit. (Natural size) 89
48. Outlines of Chedakh seed and fruit. (Natural size) 92
49. Outlines of Deglet Hamidatoo seed and fruit. (Natural size) 92
50. Outlines of Deglet Hassen seed and fruit. (Natural size) 92
51. Outlines of Khalt Menakhry seed and fruit. (Natural size) 93
52. Selatny seed and fruits. (Natural size) 93

92

B. P. I.—202.

DATE VARIETIES AND DATE CULTURE IN TUNIS.

INTRODUCTION.

During the autumn and winter of 1904–5, while traveling as agricultural explorer for the Office of Seed and Plant Introduction and Distribution, the writer, at the suggestion of Mr. W. T. Swingle, made two trips to the oases of southern Tunis in order to study the varieties of the date palm grown there and to secure offshoots of the more promising sorts for introduction into the United States. The first visit was made in October and November, the period when the fruits of most of the varieties are ripening and when the harvest is in full progress. On that occasion six weeks were spent in the more important oases, and a careful study of the chief varieties was made. This was considered an essential preliminary to selecting varieties for importation, as very little has been done by Europeans in studying the characters of the almost innumerable varieties of the date palm and in ascertaining the relative merits of the different kinds.

Nowhere, perhaps, does a greater number of promising varieties occur within a restricted area than in these Tunis oases, and the opportunity for comparison of widely differing types was an exceptionally good one. In the course of the investigations a collection of 97 samples, representing 93 distinct varieties, was obtained. Descriptions of 105 varieties were drawn up on the spot from freshly gathered fruits, and in many cases the characters of the palms themselves were noted. The fruits of 85 varieties were photographed in natural size, and photographs of the trees of 34 varieties were made.

Much information was obtained regarding the fruits of the different varieties, their size, appearance, sweetness, flavor, time of ripening, productiveness, and keeping qualities. The season chosen for the visit allowed the interesting process of harvesting the dates to be observed. Attention was also paid to the subjects of irrigation, cultural methods, and of saline or " alkali " soils in relation to the date palm.

As a result of the first visit to the oases, it was possible for the writer to decide upon the varieties that seemed most desirable for introduction into the southwestern United States. To procure these varieties a second trip to the region was made for the Office of Seed and Plant Introduction and Distribution in February, 1905, and three weeks were spent in collecting and packing the offshoots. In all about 700 offshoots, representing 56 varieties, were obtained, and it required a caravan of 90 camels to transport them to the railway.

The importation of so large a number of varieties was thought desirable, because it was recognized that date culture in the United States is still in the experimental stage, and it is impossible to foresee as yet what varieties will prove most satisfactory. It is quite possible that some of those which thrive best and are most esteemed in their native countries will not succeed with us. On the other hand, varieties that are less esteemed at home may develop valuable qualities when transplanted to this continent. Furthermore, in view of the great diversity of climate and soil existing in the parts of the United States where date culture is possible, it seems altogether probable that different kinds will be found adapted to different sections. In that case the existence at some few central points in the Southwest of large collections of varieties will prove to be of cardinal importance in the development of this promising industry.

For these reasons, an effort was made to secure a few suckers of every well-marked variety of any value, while, of course, especial endeavor was directed to securing a larger number of each of the finest and most highly esteemed sorts. In a few cases the latter aim was not realized, owing to the rarity of the palms and the reluctance of the natives to part with the suckers. Of the superb Menakher date, for example, one of the principal objects of the expedition, only nine offshoots could be obtained, and most of these were smaller than could be wished. Yet at least a few offshoots were imported of all but one variety of primary value, and only two or three of the varieties that were regarded as of secondary value are wanting in the collection. It might be added that at the time of writing (October 1, 1905) from 75 to 95 per cent of the palms imported from Tunis six months previously are showing signs of growth in the different plantations in Arizona and California.

The chief object of the present report is to furnish descriptions of the Tunisian varieties imported into the United States, so that they can be identified hereafter. It is recognized that owing to the large number of varieties that have been introduced during the past five years much confusion in regard to the identity of the different sorts is likely to arise unless some attempt is made to place their characters upon record. To this end a descriptive key has been worked out, which it is believed will be found useful in identifying the Tunisian varieties. As nothing of the kind has heretofore been attempted so far as the date palm is concerned, it is hoped that, besides fulfilling its immediate object, this key will afford suggestions as to the characters that are most serviceable in distinguishing the varieties and will serve as a basis for future studies.

To supplement the descriptions contained in the key, each of the varieties imported is discussed under the headings "Varieties of primary importance," "Varieties of secondary importance," "Varieties of minor importance," and "Varieties imported but not included in the key," with respect to the quality of the fruit, time of ripening, productiveness, trunk and foliage characters, resistance to alkali, etc.

As an introduction to the study of the varieties, the important geographical and climatic features of the region are treated, together with the character of the water supply and the cultural methods in use.

CHARACTERISTICS OF THE REGION.

GEOGRAPHY.

The principal oases of southern Tunis, in which the date palm is the chief culture, form four distinct groups, the Jerid, the Nefzaoua, Gabes, and Gafsa, each group being separated from the others by wide expanses of desert. (See fig. 1.) Each group differs in many important features from the others, having its special peculiarities of climate, soil, and water supply, as well as its characteristic varieties of dates.

The Jerid is for us by far the most important group of oases, for there are found in perfection some of the finest varieties of the date palm in the world. It is the only part of Tunis in which the choice Deglet Noor dates are produced in large quantity for European markets, exporting annually from one and one-half to two and one-half million pounds of them. This report, therefore, deals chiefly with the Jerid oases. A brief account of each of the other groups is given in the present chapter, but the discussions of climate, water supply, soils, and culture of the date palm apply almost solely to the Jerid. When reference is made to some other region, it is especially designated.

THE JERID.

The name "Jerid" (French spelling, Djerid) is an abbreviation of "Beled-el-Jerid"—the "cities of date palms." The group consists of four oases—Nefta, Tozer, El Oudiane, and El Hamma—separated one from another by several miles of barren, sandy, or stony desert. They lie at the northern edge of the Sahara Desert, nestling at the foot of a line of cliffs that forms the north bank of the Shott Jerid. The Shott, which is about 68 miles long from west to east, is in winter a large, shallow salt lake, and in summer a mud flat, covered toward its center with a shining white crust of salt, much resembling, therefore, the Salton Sink in southeastern California. Its mean elevation is about 70 feet above sea level. Toward the northwest it opens into the Shott Gharsa, continued still farther westward as the Shott Melrhirh, which borders the Oued Rirh oases of Algeria.[a] Beyond the easternmost of the Jerid oases the Shott Jerid contracts into a strait, which connects it with the much narrower Shott-el-Fejej. The latter extends eastward to within a few miles of the sea, near Gabes.

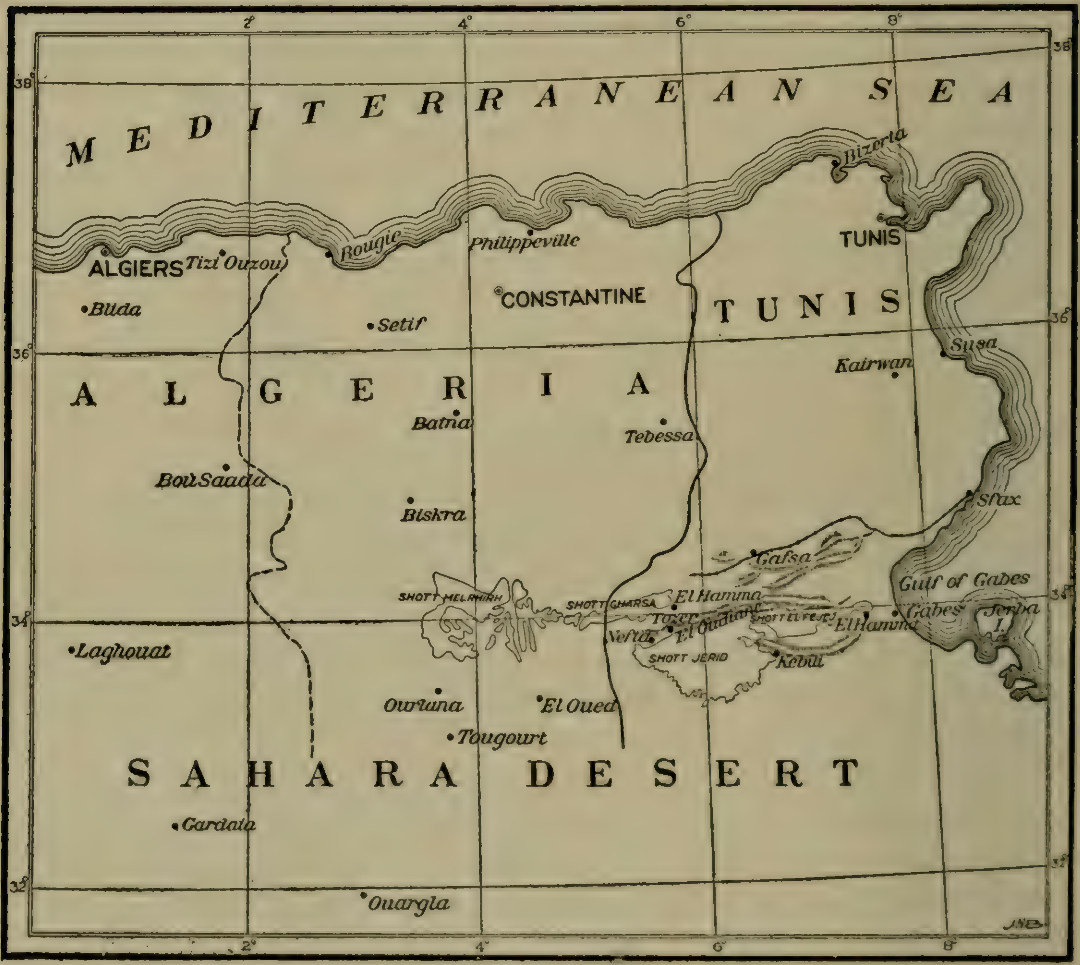

2°
4°
6°
8°
38°
36°
34°
32°
MEDITERRANEAN SEA
ALGIERS
Tizi Ouzou
Bougie
Bizerta
Philippeville
TUNIS
Blida
Setif
CONSTANTINE
TUNIS
Susa
Kairwan
ALGERIA
Batna
Tebessa
Bou Saada
Biskra
Sfax
Gafsa
Gulf of Gabes
SHOTT MELRHIRH
SHOTT GHARSA
El Hamma
Tozer
El Oudian
Nefta
SHOTT EL FEJEJ
El Hamma
Gabes
Jerba I.
SHOTT JERID
Kebili
Laghouat
Ourlana
El Oued
Tougourt
SAHARA DESERT
Gardaia
Ouargla

FIG. 1.—Map showing the location of the Tunis oases with respect to other localities in Algeria and Tunis.

Near its western end the Shott Jerid is bordered on the north by a barren, rocky line of bluffs of the pliocene formation, which farther east rises into the Jebel Sherb range of mountains. This escarpment, known as the Draa-el-Jerid, runs nearly east and west. West of Nefta it ends in a promontory extending between the Shott Jerid and the Shott Gharsa. It is virtually the southern edge of an arid, generally stony plain, almost devoid of vegetation, which extends northward to Gafsa and beyond, rising gradually into the elevated plateau of central Tunis. This plain is intersected by desolate ranges of hills and by deep ravines that contain water only at long, irregular intervals.

---

[a] See Bul. 80, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1905, p. 18.

At the southern base of the Draa-el-Jerid bluffs, and sloping toward the Shott Jerid, lie the three oases of Nefta, Tozer, and El Oudiane, the first being the westernmost. Tozer is 15 miles east of Nefta and El Oudiane about 6 miles east of Tozer. These three oases are well sheltered from the north wind by the terrace behind them, but lie open to the south. On the other hand, El Hamma, 5½ miles north of Tozer, lies on the northwestern side of the Draa-el-Jerid, having the Shott Gharsa to the west, and while protected on the south and east sides it is much exposed toward the north and west.

In general aspect all four oases are much alike. They consist of almost unbroken forests of date palms, divided up into many gardens that are separated by mud walls and intersected by innumerable irrigation and drainage ditches. The total number of date palms in the region is variously estimated at from 600,000 to 1,000,000. It has been estimated[a] that the average annual production of dates in the Jerid is about 34,700,000 pounds, of which somewhat more than 5 per cent are of the Deglet Noor variety. (See p. 63.) Of the total product of other varieties, about one-third is consumed on the spot, the rest being exported to various parts of northern Africa.

In the shade of the palms (Pls. I; V, fig. 2, and VI) are grown many other kinds of fruit trees—oranges, olives, figs, apricots, peaches, pomegranates, and jujubes—interlaced with large grapevines that often hang in festoons from the palm trunks. Beneath the trees are small plots of garden vegetables, barley, and alfalfa. Neither date palms nor other trees are planted with any regularity, and the growth is often so dense that the garden resembles a tropical jungle.

Very beautiful are these gardens in the spring, when the apricot and peach trees are in blossom here and there among the palms and the figs and vines are putting forth their leaves. In autumn, when the dates are ripening, the color effects, especially when the tops of the palms are lit up by the last rays of the setting sun, are something that once seen can never be forgotten. The great clusters of fruit, displaying every tint from bright yellow, through orange, vermilion, and maroon, to plum purple and chestnut brown, with their brilliant yellow or rich orange ivory-like stalks, contrast superbly with the dull bluish or gray green of the feathery crowns of foliage. It is small wonder that a whole folklore of poetic legends and proverbs has grown up around the date palm in the regions where it flourishes.[a]

---

[a] By Dollin du Fresnel, Le Djérid Tunisien. Bul. de la Soc. de Géogr. Comm. 22: 38 (1900).

The oases, especially Nefta, were formerly much exposed to the encroachment of the wind-blown sand of the desert, but since the French occupation the forestry service has taken effective measures to protect them from this danger. Around each oasis, at a distance from the edge of the gardens generally of 1,000 feet, although varying according to circumstances, a mud wall, surmounted by a fence of palm leaves, has been erected. The sand drifts against this, forming an artificial dune sloping outward. As fast as this dune increases in height, the palisade is built higher. The slopes of the dune itself are planted with tamarisks, retam, and other desert shrubs suitable for binding the sand. The zone between the palisade and the gardens is strictly forbidden to the domestic animals that were formerly pastured there, as they kept the soil in a loose condition and prevented the growth of the natural vegetation that helps to hold it in place. At the most exposed points a series of outer palisades, erected at regular intervals, arrests a good part of the sand before it can reach the barrier which is nearest the gardens.

---

[a] A number of these legends and beliefs are related by Charlet (Les Palmiers du Mzab, Bul. Soc. Géogr. d'Alger, 1905. Mohammed enjoined the care of the date palm as an almost religious duty, saying, "The palm is your aunt—the sister of your father Adam." He also spoke of the date as "the only fruit which has in heaven the same flavor as upon earth," and described in these glowing terms the palms that grow in paradise: "Trunks of gold, spathes of gold, branches of gold, leaves of gold, stalks of gold, petals of gold, fruits as large as buckets, softer than butter, sweeter than honey." Another Arab poet imagined thus the dates of paradise: "They will be whiter than milk, more transparent than honey, softer than butter; they will have no stones." The origin of the date palm is often the theme of Mohammedan writers. "When God had shaped Adam's body with his hands, a little of the earth which He had used to fashion in his image our first father stuck to his fingers. He rolled it between his hands, making from it the trunk of the palm." The Arabs profess to see many points of resemblance between the date palm and man, its friend and ally. "Like man, it holds up its head; like man, it has a companion of a different sex. Its heart (terminal bud), immaculately white, is as tender and delicate as the brain of a man, the least hurt causing its death. Like man, it fears cold. If one of its branches be cut off, it does not grow out again, and thus is like a man's limb. If one cuts off its head, it dies. The fiber (leef) that surrounds its head resembles human hair." The little circle, about 1.5 millimeters in diameter, that is found on the back of the stone is believed to be the impress of the seal of Solomon.

The Jerid region was evidently occupied by the Romans, and fragments of structures belonging to their epoch are frequently met with. Both Nefta (Nepte) and Tozer (Thusuros) are situated on or near the site of ancient Roman towns. Although frequently harried and pillaged by the nomadic Arabs and by other wild tribes of the desert, the oases of the Jerid have been, so far as we know, in a continuous state of cultivation throughout the Christian era. An Arab author of the eleventh century celebrated in glowing terms their fertility of soil and the beauty of their dense forests of date palms. "No other place in Africa," he wrote, "produces so many dates."

Until the completion of the railway from Sfax, on the east coast of Tunis, to the rich phosphate mines a few miles to the west of Gafsa (see map, fig. 1), the main artery of communication of the Jerid with the coast was the road, or rather trail, across the Shott Jerid, through the oases of the Nefzaoua, and then along the southern bank of the Shott-el-Fejej to Gabes, the total distance from Tozer to Gabes being about 120 miles. All the dates at that time exported from the Jerid to Europe had to be carried over this road by caravan. Now, however, Tozer is only about 35 miles from the end of the railway, and communication with the outside world is comparatively easy.

The total population of the Jerid oases is about 30,000, Tozer and Nefta each counting about 9,000 inhabitants. Practically this entire population is supported by date culture, as the other agricultural products of the oases are of so little importance as to be almost negligible and only a very small fraction of the population supports itself by manufacturing various fabrics.

Nefta, the most western oasis of the Jerid, is said to occupy over 6,000 acres. The number of date palms it contains is variously estimated at from 180,000 to 385,000, of which only 14,000 are said to be of the Deglet Noor variety.[a] The oasis consists of two distinct parts; on the north a deep basin, called by the French the "Corbeille" (basket), in which arise the springs that water the gardens, and on the south the fan-shaped larger portion, extending to the low salt flats that fringe the Shott Jerid. The town of Nefta (Pl. VI, fig. 3), the holy city of southern Tunis, lies between the two segments of the oasis and is itself separated into two parts by a deep ravine (shown in the foreground of Pl. VI, fig. 3). Through this ravine runs the stream that carries the waters of the springs from the "basket" to the lower part of the oasis. The palms that occupy the "basket" are of unusual beauty. It is said that a few years ago an English company made an unsuccessful attempt to purchase this part of the oasis.[a]

---

[a] But by the same authority the total number of all kinds is given as only 180,000.

Better sheltered as it is than Tozer, especially on the north, and said to possess a more fertile soil, Nefta is well situated for date growing, and its palms yield fruit of high quality. Its gardens are celebrated for their beauty, containing many orange, apricot, fig, and other fruit trees, in addition to the date palms, which are largely of choice varieties. More vegetables, grain, and alfalfa (Pl. VII, fig. 2) are grown here than in the other oases of the Jerid. On the side toward the Shott new palm gardens are being established (Pl. VII, fig. 2) and are planted as far as possible to the Deglet Noor variety.

Tozer oasis lies about 15 miles east of Nefta. The oasis proper extends eastward and southward from the town of Tozer, which, like all the towns of the Jerid, occupies high, open ground outside the gardens. It is the political capital of the Jerid region. The elevation of the town above sea level is about 153 feet, but the oasis is several feet lower. The area of this oasis is variously given as 2,650, 5,400, and 7,400 acres, but it is probably larger than that of Nefta. Different authorities state the number of palms contained in this oasis at from 250,000 to 417,000, of which only about 14,000 are of the Deglet Noor variety. The gardens of Tozer differ from those of Nefta in the smaller development of subsidiary cultures. The chief fruit trees, other than date palms, are figs and pomegranates.

The oasis of El Oudiane begins about 5 miles east of the town of Tozer and extends for about 5 miles along the northern border of Shott Jerid, in a band that is from one-half mile to 2 miles wide. It lies so near the Shott that in winter the salt water sometimes rises nearly to the gardens. It is generally described as a group of five oases, but these are practically continuous, although each has its own village. The westernmost, known as El Degache, contains the finest gardens. The terrace, at the base of which the oases lie, is here much higher and closer to the gardens than at Tozer and Nefta, and El Oudiane is the best protected from the north wind of all the Jerid oases. Hence its dates, especially those of the Deglet Noor variety, are admitted on all sides to be the finest produced in the region.

There are estimated to be from 120,000 to 212,000 date palms in the El Oudiane oases. As 8,000 of these are said to be Deglet Noors, the percentage of that variety is considerably higher than in the other oases. Besides the magnificent date palms, there are about

---

[a] The "basket" of Nefta reminds one of the sunken gardens of the Oued Souf (Bul. 86, Bureau of Plant Industry), but is much larger than any of them

25,000 olive trees in the El Oudiane group, most of these being at Degache, where much oil is made for local use. There is also an abundance of other fruit trees, oranges, figs, pomegranates, apricots, grapevines, and even a few bananas. In fact, the gardens of El Oudiane are among the best kept and the most attractive in the Sahara. The population is more active and laborious than that of the other oases of the Jerid.

El Hamma, situated about 5½ miles north of Tozer, lies on the northwest point of the Draa-el-Jerid terrace, on the south declivity of which the other oases are placed. The oasis slopes westward to the Shott Gharsa, instead of toward Shott Jerid. It is practically unsheltered from the north wind, which is probably the chief reason why its dates are the poorest of the region. It contains only 60,000 or 70,000 palms, of which but 800 are Deglet Noors. With a few exceptions, the gardens of this oasis are neglected and have grown up in weeds and grass. Many of the palms receive no attention whatever, and many seedlings of inferior quality have been allowed to spring up. The population is sparse and seems to be thoroughly disheartened. Dates are said to mature less perfectly here than in the other oases.

THE NEFZAOUA.

The region known as the Nefzaoua occupies a narrow peninsula that is bounded on the south by the eastern end of the Shott Jerid and on the north by the Shott-el-Fejej. The latter, which is merely a prolongation of the former, extends eastward to within 14 miles of the coast, near Gabes. From Fetnassa, the northwesternmost oasis of the Nefzaoua group, to Kriz (El Oudiane), the nearest point in the Jerid, the distance is about 30 miles, the road leading diagonally across the salt-crusted mud flats of the Shott Jerid. From Kebili, the capital of the Nefzaoua (see map, fig. 1), to Gabes, on the coast, the distance is about 64 miles as the crow flies, the direction being a little north of east. By the road usually traveled, which follows the south shore of the Shott-el-Fejej, the distance is somewhat greater. Before the railway from Sfax to the phosphate mines west of Gafsa was built this road formed the principal outlet to the coast for the Jerid as well as the Nefzaoua oases. Along this route there are a few small oases, but no important ones are encountered until one nears Gabes.

The Nefzaoua comprises a large number of oases—more than 1,000, according to the estimates of reliable authorities. Most of these, however, are mere small groves of palms, only forty of them attaining any considerable size. They are situated both on the north and the south slope of the stony ridge that forms the backbone of the peninsula. This ridge is the western extension of the desert mountain range known as the Jebel Tebaga, which forms the southern border of the Shott-el-Fejej. The oases that are on the south side of this ridge are naturally more sheltered from the north wind and better situated for the ripening of dates than those on the north side.

The population of the Nefzaoua is stated to be 25,000, distributed in 45 villages. The total number of date palms in the region is estimated by one authority to be 280,000, by another over 1,000,000. The first estimate is probably more nearly correct. It is a peculiarity of the Nefzaoua, which places it in strong contrast with the Jerid, that the oases are mostly situated upon the higher lands. The reason is that nearly all the springs are found craterwise at the summits of small volcano-like hillocks, and the gardens of date palms have grown up around them. The water supply is abundant, and owing to the situation of the springs with relation to the gardens irrigation is generally easy. In the oasis of Menchia, however, the gardens are generally some distance away from the springs, and water is conducted to them by means of tunnels that have been bored into the sides of the hills in which the springs rise. Some of these tunnels are said to have been constructed in the times of ancient Rome, this region also having been occupied by the Romans. In the Nefzaoua, as in the Jerid, the water sheet is located in cretaceous strata.

Menchia is the most important of the oases on the north side of the ridge. Its soil is sandy and contains much gypsum, but not an excessive amount of the more readily soluble salts. On the south slope the oasis which pertains to the two villages of Tlemine and Mansourah is the largest, and its gardens are the best kept of the region. It is said to contain 29,000 palms, while the next largest oasis, Kebili, contains 20,000. In these two oases the soils are generally excellent, although frequently a trifle salty.

The culture of the date palm is generally given less care in the Nefzaoua than in the Jerid. Many of the gardens have been allowed to grow up in seedlings of poor quality and are almost choked with weeds. The Deglet Noor variety has not heretofore been grown in the Nefzaoua, although the conditions would appear to be perfectly suitable for it. Recently the forestry service has taken some steps toward establishing its culture in some of the oases. The growing of other fruit trees and of crops of vegetables, cereals, and forage plants among the palms receives much less attention than in the Jerid. A great deal of trouble has resulted from the incursion of wind-blown sand, and here, as in the Jerid, the forestry service has had to undertake the protection of the oases by constructing palisades and by prohibiting the pasturing of animals on the outskirts of the gardens.

South of Kebili there is a region of sand dunes, and here the palms, according to M. Minangoin, inspector of agriculture, are grown in sunken gardens, similar to those of the Oued Souf region,[a] but on a smaller scale. In the oasis of Douz, about 16 miles south of Kebili, this form of date culture reaches its highest development in Tunis. There basins among the dunes are excavated to a depth of about 13 feet and often 100 to 130 feet square (the sand being carried out in baskets) in order to plant a dozen or so palms and a few other fruit trees. The palms grown with such an enormous expenditure of labor almost always belong to inferior varieties. During several months of each year most of the population of this oasis migrates in search of pasturage for its flocks. Upon the return of the inhabitants they must immediately set to work to clear out the sand that has invaded their gardens, a task that requires nearly as much labor as the original excavation.

GABES.

In extreme southern Tunis the Sahara Desert practically reaches the seashore, forming the region known as the "Aarad." One of the largest and most flourishing groups of oases in the country is that which has for its center the seaport town of Gabes. These oases are well supplied with water, those nearest Gabes chiefly by means of a series of little dams in the Oued Gabes (Gabes River) and its branches, the more distant ones from springs and wells. The large oasis of El Hamma—of the same name as one in the Jerid region—is famous for its hot springs. This oasis has an area of about 4,000 acres, and the combined area of those nearer Gabes is said to be about the same.

About 400,000 date palms are estimated to exist in the oases of Gabes and El Hamma together. At Gabes the humidity, due to the proximity of the sea, prevents the successful growing of the finer varieties, notably the Deglet Noor. While the date palm itself thrives admirably in the Gabes region, and a great number of varieties exist there, the fruit produced is far inferior in flavor and sweetness to that of the Jerid and the Nefzaoua. Moreover, it is said not to keep well and easily to become moldy. The same criticism applies to the dates grown on the neighboring island of Jerba, where also there are about 400,000 palms.[b] But at El Hamma, although only 15½ miles inland, the quality of the dates is appreciably better.

---

[a] See Bul. 86, Bureau of Plant Industry, U. S. Department of Agriculture, 1905.

[b] It is interesting to know that some kinds of dates can be ripened on the seacoast, even considerably farther north than Gabes. M. Minangoin, inspector of agriculture at Tunis, in a letter to the writer, describes a small oasis of 4,000 to 5,000 palms, situated on a sand spit near Susa (Sousse), about 120 miles north of Gabes. Two kinds of dates are grown, of one of which the fruits must be eaten the day they are gathered, while the other kind can be kept for only

In respect to other cultures, however, Gabes is easily first among the Tunis oases. Garden vegetables grow to perfection beneath the palms and mature so early that were there better facilities for transportation there would be a large profit in shipping them to European markets. Alfalfa grows beautifully and gives a rapid succession of cuttings throughout most of the year. Large yields of barley are obtained. Fruit trees of various kinds, but especially figs and pomegranates, are abundant and produce fruit that is highly esteemed throughout Tunis. Gabes is celebrated for the production of a small, deliciously flavored banana that is exported in some quantity to Europe. The grapevine grows to enormous size, and individual vines that produce 330 pounds of fruit are said to be not uncommon. Notwithstanding the scanty rainfall, plantations of oil olives in land that is not irrigated, similar to those of Sfax, are being established on the outskirts of some of the oases.

GAFSA.

The town of Gafsa is situated about 50 miles northeast of Tozer, the capital of the Jerid, and is connected with Sfax, on the east coast of Tunis, by a railway about 125 miles long. The elevation of Gafsa above sea level is about 1,150 feet. Tributary to the oasis of Gafsa itself are one or two other oases of small importance. Gafsa oasis contains from 50,000 to 65,000 date palms. These belong mostly to inferior varieties, and the dates produced are of mediocre quality. Because of its much greater elevation this locality is entirely unsuited to choice varieties, such as the Deglet Noor. The water supply is more than ample for the present extent of the oasis. The date is here hardly a more important crop than the olive, of which there are many thousands of trees. Oil varieties predominate. At the beginning of the Christian era Gafsa (then known as Capsa) was included in the great olive zone that extended from the east coast of Tunis across into Algeria, and of which only scattered fragments remain.

---

four or five days. These must be picked from the bunches as fast as they ripen, which necessitates climbing each palm every day until all of its product is harvested. These dates are sold in the markets of Susa at a rather high price, as they ripen at a time when other fresh fruit is not obtainable. They are eaten only by the natives, Europeans holding them in small esteem. The high value set upon them by the natives is shown by the fact that the offshoots are sold at a price of $2 apiece. While the two varieties grown at this locality are doubtless of little intrinsic value, it is remarkable that dates of any sort will mature under these climatic conditions; for at Sfax, where the summers are slightly hotter than at Susa, the normal sum total of mean daily temperatures from May 1 to October 31 is only 1,968° F., and the normal sum of mean daily maxima during the same period is only 3,375° F.

At the present time the culture of the olive as carried on at Gafsa leaves much to be desired, and the gardens are generally not well cared for. The pomegranates of Gafsa are considered the best grown in Tunis.

CLIMATE.

The climate of southern Tunis is essentially that of a desert, although modified by the nearness of the sea. This modification is, of course, most marked at Gabes, on the coast, which has a more humid atmosphere and lower summer temperatures than the other oasis groups, and is consequently not well adapted to the culture of the finest varieties of dates. At Gafsa the air is drier than at Gabes, but the high altitude (1,000 feet) lowers the temperatures and shortens the summer to a degree that renders this oasis unsuitable for the late-ripening varieties. Only in the Jerid and the Nefzaoua oases do we find the climatic conditions that are necessary for the perfect ripening of the finest sorts of dates.

TEMPERATURE.

In the following tables data are given for five localities in Tunis where the date palm is the principal culture, viz, Tozer and Nefta (Jerid), Kebili (Nefzaoua), Gabes, and Gafsa. The normals for the different localities and for different months have been compiled from records of observations covering periods of unequal length, being from nine to thirteen years at Tozer. The monthly normals for Gabes and Gafsa have been corrected so as to agree with the normals of fifteen years for each season (winter, spring, summer, and autumn).[a] All temperatures are given in degrees Fahrenheit.

---

[a] As given by G. Ginestous (Etude sur le Climat de la Tunisie, Bul. Dir. Agr. et Com., Tunis, 1902, pp. 64, 210, 334, 413; 1903, p. 103). The discrepancy between the seasonal normals given by this author and the monthly normals compiled from various sources is usually only a fraction of 1 degree Fahrenheit for each month, although sometimes amounting to 3 or 4 degrees. The monthly normals have been compiled from the records published in the Annales du Bureau Central Météorologique de France and in the quarterly Bulletin de la Direction de l'Agriculture et du Commerce de Tunis. Those for Nefta and Kebili, localities for which seasonal normals are not given by Ginestous, are based upon short periods of observation, in no case exceeding six years, and in some cases of only three years, although generally four or five years.

TABLE 1.—*Normal mean temperatures of localities in the desert regions of Tunis, Algeria, and the United States.*

Month.	Tunis.					Algeria.			United States.		
	Tozer.	Nefta.	Kebili.	Gabes.	Gafsa.	Biskra.	Tougourt.	Ouargla.	Phoenix, Ariz.	Yuma, Ariz.	Volcano Springs, Cal.
January	51.3	50.5	49.6	51.8	49.2	50.5	47.3	46.8	49.8	54.1	55.9
February	55.9	56.3	56.5	55.6	53.7	53.2	49.8	51.8	54.3	58.6	60.5
March	62.1	61.1	61.7	59.7	58.1	58.3	54.9	59.9	53.9	63.9	68.4
April	68.7	69.2	71.9	64.2	64.2	63.1	64.0	66.4	67.0	69.9	79.7
May	76.1	74.5	74.8	69.2	71.4	71.8	74.8	73.6	74.4	76.9	87.5
June	86.2	84.3	84.1	76.3	80.4	80.6	86.0	82.4	83.9	84.4	96.6
July	92.0	89.1	89.4	81.3	85.6	87.1	92.1	90.7	90.2	91.2	101.3
August	92.0	88.8	87.0	81.0	85.4	85.8	85.1	86.0	88.2	90.4	99.7
September	83.1	83.8	82.5	80.0	81.7	78.8	83.7	78.1	81.4	84.3	89.5
October	73.0	72.9	72.5	72.8	71.3	67.6	68.4	63.5	69.3	72.4	78.4
November	61.7	61.4	59.8	62.9	59.8	57.2	58.5	52.9	58.5	62.3	67.0
December	52.3	53.0	52.0	54.3	48.6	51.3	48.9	45.0	52.3	55.9	57.4
Year	71.2	70.4	70.1	67.4	67.4	67.1	67.8	66.4	68.6	72.0	78.5

Comparing the Tunis localities among themselves, we notice that during most of the year the Jerid oases (Tozer and Nefta) are the warmest, and that next to them is the Nefzaoua (Kebili). In November, December, and January, however, the highest means are reached at Gabes, on the seacoast. The normal yearly means are higher in the Jerid and the Nefzaoua than in any of the Algerian oases. The difference is particularly noticeable during the winter months, when the means are decidedly lower in the Algerian oases than in those of the Jerid and the Nefzaoua. The normal means of most months are higher in the Jerid and Nefzaoua oases than at Phoenix, Ariz., but lower than at Yuma, Ariz. They are much lower in every month than at Volcano Springs, Cal.

TABLE 2.—*Normal mean maximum and minimum temperatures of localities in the desert region of Tunis.*

Month.	Mean maxima.					Mean minima.				
	Tozer.	Nefta.	Kebili.	Gabes.	Gafsa.	Tozer.	Nefta.	Kebili.	Gabes.	Gafsa.
January	59.4	63.7	57.9	62.7	59.5	42.8	37.7	39.2	40.7	39.5
February	65.5	70.0	65.8	67.6	66.2	46.5	41.3	41.9	43.6	39.3
March	72.5	76.1	72.5	71.3	70.4	52.3	47.3	48.2	48.6	44.6
April	81.3	86.5	84.4	76.0	80.7	56.8	54.1	56.8	53.5	49.9
May	89.1	89.0	88.3	78.9	85.2	65.3	60.2	60.2	58.0	56.3
June	99.7	99.2	96.9	85.3	96.5	74.1	69.2	68.2	67.2	63.9
July	107.1	104.9	103.8	90.8	102.8	77.6	73.2	73.4	71.0	69.7
August	104.6	103.8	101.3	91.4	101.2	79.5	74.4	72.2	71.8	69.1
September	93.7	98.3	95.1	91.9	96.2	72.5	69.5	69.8	71.0	66.0
October	83.2	86.1	82.6	83.6	84.0	63.1	58.1	60.6	61.5	57.3
November	70.5	76.1	70.6	73.3	75.0	53.2	50.5	48.2	50.5	47.2
December	60.3	71.0	61.1	65.6	60.2	44.7	40.1	42.4	44.2	37.7
Year	82.2	85.4	81.7	78.2	81.5	60.7	56.3	56.8	56.8	53.4

As is shown by the foregoing table, the normal yearly maxima are highest in the Jerid oases (Tozer and Nefta) and are lowest at Gabes, on the coast. In winter the maxima are higher at Nefta,[a] but lower at Tozer than at Gabes. At Tozer the minima are higher for nearly every month than at any other locality in Tunis, while at Nefta those for June, July, and August are higher than at any other locality excepting Tozer. Comparing Gafsa, which has an elevation above sea level of 1,000 feet, with Gabes, on the coast, we find the maxima higher at the former point in all seasons except winter. The minima are lower at Gafsa than at Gabes in every month of the year.

A climatic factor upon which the success of date culture largely depends is the sum total of heat received during the ripening period, which can be taken as comprising the six months from May 1 to October 31. As it is still a question whether the sum total of the daily means or those of the daily maxima give the best expression of this factor, both sums have been computed for the Tunis localities, and are given in the following table. Following the suggestion made by Mr. W. T. Swingle,[b] the sums of the daily means are based upon the excess of the normal monthly means over 64.4° F., while in computing the sums of the daily maxima above 64.4° deduction has been made for normal monthly minima that fall below that temperature.

---

[a] As pointed out on p. 21, however, the results for Nefta and for Kebili are based upon too short periods of observations.

[b] Bul. 53, Bureau of Plant Industry, pp. 65–68.

TABLE 3.—*Sums of daily mean and daily maximum temperatures above 64.4° F. from May 1 to October 31, at localities in the desert regions of Tunis, Algeria, and the United States.*[a]

Locality.	Sum of daily mean temperatures.	Sum of daily maximum temperatures.	Period covered by observations.	Remarks.
Tozer, Tunis	3,555.5	5,818.5	9 to 13 years	All varieties, including Deglet Noor, ripen perfectly.
Nefta, Tunis	3,277.7	5,710.4	3 to 6 years	Do.
Kebili, Tunis	3,183.1	5,357.6	4 to 5 years	Several first-class varieties ripen perfectly. Deglet Noor not yet grown.
Gabes, Tunis	2,272.7	3,936.5	15 years	Finest varieties do not ripen well; even second and third class dates do not always ripen perfectly.
Gafsa, Tunis	2,738.1	4,943.9	do	Too cold to mature the finest varieties.
Biskra, Algeria	3,304.0	5,489.0	10 years (means), 12½ years (maxima).	Many varieties ripen perfectly, but the Deglet Noor is generally unsatisfactory.
Ayata, Algeria	3,488.0	5,932.0	3 years (means), 4 years (maxima).	Deglet Noor ripens well in hot summers, imperfectly in cool summers.
Phoenix, Ariz	3,019.0	5,523.0	Many years (means), 4 years (maxima).	Many varieties ripen well, but not the Deglet Noor.
Salton, Cal	4,823.0	7,306.0	12 years (means), 2 average years (maxima).	Dates not grown.

It would appear that for purposes of comparison of different localities as to their suitability for the culture of fine varieties of dates the sums of the daily maximum temperatures are more satisfactory than those of the daily means. For at Biskra, Algeria, where the Deglet Noor seldom ripens properly, the normal sum of the daily means is higher than that given above for Nefta, and only 250 degrees lower than at Tozer, yet at both of these Tunis localities the Deglet Noor rarely fails to mature, while the normal sums of the daily maxima both at Tozer and at Nefta are considerably higher than at Biskra. Furthermore, at Ayata, Algeria, in 1891, when Deglet Noor dates ripened "very slowly and imperfectly," the sum of the daily means was 3,431, or only 124 degrees lower than the normal for Tozer as given in the table. But in favor of the sum of the means rather than of the maxima is the fact that at Ayata, where the Deglet Noor does not ripen well every season, the normal sum of the maxima is nearly 100 degrees higher, while that of the means is about 70 degrees lower than at Tozer. At Phoenix, Ariz., where the Deglet Noor will probably not mature, the sums of daily mean and daily maximum temperatures are several hundred degrees lower than at Tozer. At Salton, Cal., however, both sums are so very much higher than at Tozer that, even when we make a considerable allowance for the probable overestimate, due to the way the observations have been taken at Salton (see p. 24), we can not doubt that the Salton Basin is hot enough for the perfect ripening of all the Tunis varieties of dates. At Gabes, on the coast of Tunis, only second or third rate varieties are grown, and even these often fail to mature well, as would be expected from the low sums of temperature (much lower than at Tucson, Ariz.). At Gafsa, also, where the sums of the daily mean and daily maximum temperatures are, respectively, nearly 300 and nearly 500 degrees lower than at Phoenix, none of the first-class varieties can be successfully grown.

---

[a] The sums for Biskra and Ayata, Algeria, and for Phoenix and Salton, in the United States, are those given by Swingle, Bul. 53, Bureau of Plant Industry, pp. 66 and 68. As explained by Mr. Swingle, the method of observing temperatures formerly used at Salton has probably made the sum for that point appear to be higher than is actually the case.

A comparison of the weather of several successive years at Tozer during the six months that are most decisive in the ripening of dates, with statements of the character of the succeeding crops, is presented in the following table:

TABLE 4.—*Climatic conditions and character of date crop at Tozer, 1901 to 1905.*

Year.	Sum of means, May to October.	Sum of maxima, May to October.	Rainfall, May to October.	Character of crop.
1901	3,459	5,335	May 0.87 June July August September 1.07 October .84 2.78	Yield not stated. Quality lowered by September rains, especially inferior sorts, which contained many worms.
1902	3,899	5,922	May June July August September 0.64 October 1.78 2.42	Crop very large, but quality somewhat injured by autumn rains.
1903	3,309	5,793	May June July August September 0.93 October .93	Crop much smaller than in 1904.
1904	3,719	5,622	May June July August 0.08 September .13 October .13 .34	Crop very large and of excellent quality.
1905	3,565	5,643	May 0.17 June .75 July .11 August September October .40 1.43	Harvest retarded until October 23-26. Dates ripened imperfectly.

Judging by the data for 1904, the period of the writer's visit, when the crop was admitted on all sides to be an unusually fine one, both as to the quality and quantity of the fruit, it would seem as if the sum of the daily means, which in 1904 was more than 150 degrees higher than the normal, were a more satisfactory basis for comparing one season with another at the same locality than the sum of the daily maxima, which was about 200 degrees lower than the normal. Furthermore, in 1905, when the ripening of the dates was late and imperfect, the sum of the daily means was nearly normal, while that of the daily maxima was again nearly 200 degrees lower than the normal. In 1903, when the crop was much smaller than in 1904, the sum of the daily maxima was only 25 degrees lower than the normal, while the sum of the daily means was nearly 250 degrees below the normal. Still more conclusive are the data for 1902, a year when the crop was unusually large. The sum of the daily maxima of that season was only 100 degrees higher, while that of the daily means was 350 degrees higher than the normal.

Table 5.—*Mean maximum and minimum temperatures at Tozer during the months of May to October, 1904 and 1905.*

Year.	May.		June.		July.		August.		September.		October.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1904	90.3	65.3	89.2	75.7	104.7	85.4	108.7	84.4	96.2	73.7	83.1	61.3
1905	89.4	63.5	98.2	72.7	105.0	80.0	104.3	79.7	97.3	75.9	78.6	62.8

Comparing further the good year 1904 with the poor year 1905 at Tozer, we find that while the mean maximum was much higher in June and slightly higher in July in the latter year, the August and October maxima were considerably higher in 1904, while those for May and September differed little in the two years. The mean minima during the first four months of the season were considerably higher in 1904 than in 1905.

ATMOSPHERIC HUMIDITY.

The amount of moisture in the air is an important factor in date culture. At Gabes, in Tunis, one of the few localities in the world where the date palm is extensively grown on the seacoast, the quality of the fruit is often seriously impaired by this cause (see p. 19). In the following table the mean relative humidity for each of the four seasons and for the year is given for several localities in North Africa, where date culture exists, and for localities in the southwestern United States, where it can probably be successfully introduced.

TABLE 6.—*Mean relative humidity at localities in the desert regions of Tunis, Algeria, and the United States.*

Season.[a]	Tunis.			Algeria.		United States.
	Tozer.	Gabes.	Gafsa.	Biskra.	Ouargla.	Yuma.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Winter	70.6	70.1	64.0	59.8	48.5	46.9
Spring	63.0	65.0	57.6	47.7	46.4	38.3
Summer	52.0	64.1	47.0	34.9	30.1	41.7
Autumn	59.6	67.6	59.6	51.3	47.6	44.7
Year	61.3	66.7	57.0	48.4	43.1	42.9

[a] Winter comprises December, January, and February; spring, March, April, and May; summer, June, July, and August; and autumn, September, October, and November.

As shown by the above table, the Tunis oases have at all seasons a decidedly more humid atmosphere than those of Algeria. At Yuma the air is drier than at any of the North African localities, except in summer, when Yuma is more humid than Biskra and Ouargla. Comparing the three Tunis localities one with another, we find that at most seasons the humidity is greatest at Gabes, as would be expected from its situation on the coast, and least at Gafsa, which lies in the midst of extremely arid elevated plains and is cut off from the sea by ranges of desert mountains. Tozer in winter is slightly more and in spring little less humid than Gabes, but in summer and autumn it is decidedly drier. All things considered, the humidity at Tozer is surprisingly higher for a locality where the finest kinds of dates are produced.

PRECIPITATION.[a]

TABLE 7.—*Normal precipitation, in inches, at localities in the desert regions of Tunis, Algeria, and the United States.*

Season.	Tunis.				Algeria.			United States.		
	Tozer.	Nefta.	Gabes.	Gafsa.	Biskra.	Tougourt.	Ouargla.	Phoenix, Ariz.	Yuma, Ariz.	Volcano Springs, Cal.
Winter	1.7	1.4	2.8	2.4	2.1	2.0	1.4	2.3	1.3	1.1
Spring	2.4	2.1	1.9	3.4	2.2	1.6	1.4	1.0	0.4	0.1
Summer	0.1	0.2	0.1	0.6	0.6	0.1	0.1	2.0	0.5	0.2
Autumn	0.7	0.7	2.7	1.9	1.8	1.3	0.7	1.5	0.6	0.2
Year	4.9	4.4	7.5	8.3	6.7	5.0	3.6	6.9	2.8	1.6

The total annual rainfall of the Jerid oases (Tozer and Nefta) is very much less than that of Gabes, on the coast of Tunis, and of Gafsa, which has an elevation of 1,000 feet above sea level. Tozer has about the same total precipitation as Tougourt, in Algeria, considerably more than Ouargla, Algeria, and considerably less than Biskra, Algeria, and Phoenix, Ariz., the last two localities having nearly the same total. The Colorado River Valley and the Salton Basin in the United States receive considerably less rain than any of these North African localities. Regarding the distribution by seasons, we find that nearly one-half of the total precipitation falls in spring in the Jerid oases, a larger proportion than at any of the other localities given in the table. The autumnal precipitation is relatively smaller at Tozer and at Nefta than at any of the other localities excepting Volcano Springs, Cal. At Phoenix and Yuma, Ariz., the rainfall in summer forms a much higher proportion of the total for the year than at any of the other points included in the table.

---

[a] The relation of the rainfall of the Tunis oases to date production is discussed under the heading "Ripening," on pp. 51 and 52 of this bulletin.

IRRIGATION AND DRAINAGE.

As the water supply and irrigation conditions of the oases of the Nefzaoua, Gabes, and Gafsa have been briefly discussed under the heading "Geography," only the Jerid region will be treated in this place.

WATER SUPPLY.

The oases of the Jerid, unlike those of the Oued Rirh, in Algeria,[a] are watered by means of springs instead of wells. This is explained by the fact that the Jerid oases are situated at the very base of the terrace that marks the northern frontier of the desert, while the Oued Rirh group lies well into the Sahara. Attempts to obtain artesian water in the Jerid region have so far been unsuccessful.

The springs of the Jerid are all situated at about the same elevation—135 to 150 feet above sea level. They originate in strata of cretaceous formation at the base of the line of bluffs. As the springs are very numerous and in many cases very large, maintaining a practically constant flow throughout the year, it seems unlikely that the scanty rainfall of the region itself can account for the abundance of the water supply.[b] The general temperature of the water as it issues from the ground is about 86° F., and varies little from season to season.

---

[a] See Bul. 53, Bureau of Plant Industry, U. S. Dept. of Agriculture, pp. 44–46, where the irrigation of the date palm in the Algerian Sahara is described; also, Bul. 80, Bureau of Plant Industry, pp. 36–38, where this subject is discussed.

[b] Rolland, Hydrologie du Sahara Algérien, pp. 182, 183, holds that the water which feeds the springs of the Jerid must constitute an artesian sheet, derived largely from the eastern spurs of the Aurès Mountains and flowing deep under the elevated plain which abuts on the shotts of southern Tunis. On the other hand, Doumet-Adanson (Sur le régime des eaux qui alimentent les oasis du Sud

The oasis of Nefta is supplied with water by a large number of springs that arise in the "Corbeille," or "basket" (p. 15). Their combined flow, amounting to about 292 gallons (1,100 liters) per second, gives rise to the stream which waters the southern part of the oasis. This quantity of water is estimated by Rolland to be sufficient for irrigating the entire oasis at the rate of about 2 acre-feet per acre annually.

Taking as the number of date palms existing at Nefta the mean of the two estimates given on page 15, we should have 282,500 trees. If the total supply furnished by the springs were divided equally among them, each would receive about 0.24 quart per minute,[a] or about 86 gallons per day. As it has been calculated by Rolland that to give the best results each date palm should be allotted at the source of supply 0.53 quart (0.5 liter) per minute (hence about 190 gallons per day)[b] it is evident that the supply available is not sufficient for the perfect irrigation of more than one-half of the date palms of the oasis.

The 140 springs that supply the oasis of Tozer with irrigating water give rise to a stream that delivers about 278 gallons (1,050 liters) per second; hence about 3,200,000 cubic feet daily. This quantity is estimated to suffice for irrigating the oasis at the rate of about 1.5 acre-feet per acre annually. Assuming that there are 385,500 palms (the mean of the two estimates given on page 16) in this oasis, and making the calculation upon the same basis as for Nefta, the share of water at the source of supply available for each tree would be only 0.17 quart per minute, or 62.4 gallons per day, which is less than one-third the amount (0.53 quart per minute) estimated by Rolland as the optimum.[c] It should be noted, however, that the distribution of water among the different parts of the oasis is very

---

de la Tunisie, Assoc. Franç. Avancem. Sciences, 1884, p. 72) regards the infiltration water drained through the sands of the adjacent region as sufficient to supply these springs. He does not consider the water sheet to be of artesian character.

[a] Rolland, assuming that there were 201,100 palms at Nefta, calculated that there should be available for each, at the source of supply, 0.33 liter (0.35 quart) per minute. In his, as in the writer's calculation, no deduction is made for the amount of water lost to the palms through seepage and evaporation from the ditches, growing of other crops, and use by the inhabitants and their domestic animals.

[b] See Bul. 53, Bureau of Plant Industry, p. 45.

[c] A much lower estimate has been made by M. Minangoin, inspector of agriculture at Tunis, of the amount of water theoretically available for each date palm in the oasis of Tozer. He states that the combined flow of the 140 springs is only 1,700,000 (instead of 3,200,000) cubic feet daily; and assuming that there are 300,000 trees in the oasis, he arrives at the figure of 42 gallons (160 liters) as representing the amount available at the source of supply for each palm daily.

unequal, the palms in some gardens being amply and even superabundantly irrigated, while thousands of trees receive no irrigation whatever, except by seepage.[a]

There is some indication that the flow of the springs at Tozer is diminishing in volume. It would appear also that there has been a gradual lowering of their level, due to the progressive cutting down of the beds of the streams derived from them, and that in consequence the irrigable area of the oasis is diminishing.[b]

In the oasis, or oasis group, of El Oudiane 60 springs furnish the water with which the gardens are irrigated. They are generally smaller than those of Nefta and Tozer, and their flow is said to be perceptibly diminishing. Their waters are not united to form a large stream which is subsequently divided and subdivided by dams, as in the oases just described, but are for the most part conducted directly to the gardens. These, owing to the small width of the oasis and its situation at the very foot of the terrace, are nowhere far removed from the sources of supply.

At El Hamma there are 15 springs of considerable size, one of them having a temperature of 107.5° F. (42° C.). To this spring, which is much frequented by the natives for the sake of the hot baths it affords, the oasis owes its name, which means "the bath."

A sample of irrigating water was collected by the writer in the main stream of Tozer, above the first dam which divides it. This water, tested both at the moment of collection and two months later, when the analysis was made, gave neither an alkaline nor an acid reaction. Its electrical resistance at the time when the sample was taken was 117.3 ohms at 60° F. The chemical analysis, made in the laboratory of the Bureau of Soils, showed 209.2 parts of soluble matter per 100,000 of water. The composition of the soluble contents was as follows, in percentages of the total:

Table 8.—*Chemical composition of irrigation water, Tozer oasis.*

Components (ions).		Conventional combinations.	
Calcium	8.50	Calcium sulphate	28.87
Magnesium	4.54	Magnesium sulphate	17.36
Sodium	9.13	Potassium chlorid	23.47
Potassium	12.34	Magnesium chlorid	4.11
Sulphions	34.23	Sodium chlorid	16.68
Chlorions	24.33	Sodium bicarbonate	9.51
Carbonic acid	6.93		
	100.00		100.00

---

[a] At Biskra, in Algeria, 0.12 quart per palm per minute is found to give satisfactory results, the water being retained at the bases of the trees in holes that are dug for the purpose. (See Bul. 53, Bureau of Plant Industry, p. 47.)

[b] Doumet-Adanson (ibid.) noticed old date palms at Tozer that could no longer be irrigated, being no less than 40 feet above the present level of the springs.

It is evident from this analysis that the water afforded by the springs of Tozer is pure enough to be used with perfect safety in irrigating any crop grown there. As the springs of the other oases of the Jerid have a similar origin to those of Tozer, it is probable that the composition of their waters differs little from the foregoing.

IRRIGATION SYSTEM.

Irrigation at Tozer has been brought to a higher stage of development than elsewhere in the Jerid, and a description of the system in use at Tozer will serve for the other oases as well.[a] It is said to have been elaborated long ago by an Arab named Ben Chabet, and to have been religiously maintained, unchanged as he planned it, to this day. The details of its management are transmitted from father to son in a certain family. Having perfected the system at Tozer, Ben Chabet offered to do the same service for the inhabitants of Nefta, who were constantly in dispute over their water rights, but their jealousy of Tozer prevented their accepting his offer. French students of the Tozer system praise very highly the ingenuity and thoroughness with which it has been worked out.

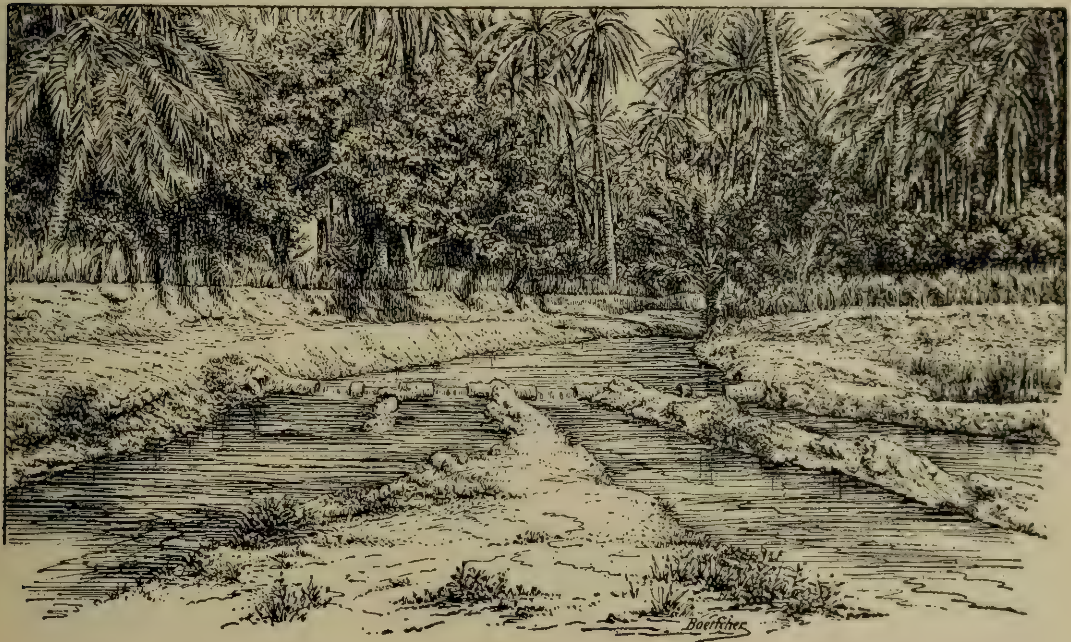


Fig. 2.—Irrigation canal and diversion dam, Tozer oasis.

The main stream which collects the waters of all the springs of Tozer is divided and subdivided by a series of dams made of palm logs (fig. 2) until the water reaches the ultimate divisions or seguias (ditches) which supply each individual garden. The log which is laid across the canal to form the dam is divided into a series of long, shallow notches, separated by narrow ridges. The number of notches in each dam corresponds to the number of parts into which the stream is to be divided at that point. Thus, if three-fifths of the water is to be diverted into one of two branches and two-fifths into the other, five notches are cut, the water passing over three of them going to the first branch and the rest to the second. The notches being all of the same length and depth, the division is quite accurate. Divisions of the main stream down to the twenty-first part of the total flow are not transferable, belonging for all time to the same district of the oasis. Smaller fractions of the water, however, can be alienated, and there is much bartering of water rights among the different proprietors of gardens.

---

[a] For a detailed account of this system, see F. Masselot, "Les Dattiers des Oasis du Djérid," Bul. Dir. Agr. et Com. Tunis, 1901, pp. 137–142.

At all the principal diversion dams, guards are stationed day and night to prevent any tampering with the water, there being three guards at the first diversion and two at each of the other important ones. These guards are paid with a bunch of Fteemy dates from each garden that receives water passing over the dam they tend, those at the first diversion being entitled to a bunch from every garden in the oasis. The "amin,"[a] or expert, who supervises the entire system has also the right to select a bunch of Fteemy dates from every garden, his being the first choice after the "khammes," or tenant, of the garden.

The principal canals are kept up by assessment upon all the owners of gardens supplied by them. Smaller ditches (seguias) must be kept in order by the tenants of the gardens served by them, and it is also the duty of the khammes (tenant) to be on hand at the small dam which diverts water into his ditch when it is the turn of his garden to receive water, for there is a fixed hour for the irrigation of each garden.

The method of measuring time in connection with this irrigation system is an interesting one. A metal cup-like receptacle, called a "gadous," is filled with water and hung up in a convenient place by the dam. The bottom of the receptacle is perforated, and the hole is always of the exact size necessary to let all the water run out in just five minutes. The water that runs over a notch in the dam during the time required for the gadous to empty eleven times (hence, in fifty-five minutes) is sufficient to irrigate thoroughly a garden of 2.4 acres (1 hectare), the length of the notch being fixed and its depth corresponding to the velocity of the current.

---

[a] The "amins" (pronounced "ameens") are selected from among the older inhabitants of the community for their knowledge of agricultural matters. Their function is to act as arbiters in disputes concerning water rights, the relations between proprietors and tenants, the sale of agricultural products, etc.

The gardens are divided into small plots by means of banks of earth, to facilitate irrigation, as in the basin method used in the United States. The water from the ditch (seguia) is turned into the nearest plot through a breach made in its bank, the ditch being dammed at that point with a few spadefuls of earth. When the soil is sufficiently saturated, the farther bank is cut, allowing the water to pass on into the plot beyond; and so on, until the whole garden has been irrigated. In this way not only the date palms, but the other fruit trees and the small crops among them that occupy a portion of every garden, are irrigated simultaneously.

DRAINAGE SYSTEM.

Owing to the situation of the oases on the edge of the Shott Jerid and the great amount of water used in irrigation, its soils would be completely water-logged were it not for the excellent provision that has been made for drainage. Each garden is provided with open drainage ditches, or "khandaks," these being generally about 166 feet apart and about 5 feet deep. They are constructed at the expense of the proprietor of the garden, the work of keeping them open devolving upon his tenant. Several of these smaller drains unite to form a large ditch, which is kept up by an association of the proprietors whose gardens are served by it, each contributing in proportion to the size of his water right. Finally, at Tozer, all the drainage ditches empty into a main one called the "Khandak-el-Kebir," which runs along the southern side of the oasis and carries its drainage water to the Shott Jerid. In former times, when Tozer was frequently raided by the savage nomadic tribes of the desert, this large drainage ditch also served the inhabitants as a moat for the defense of the oasis. Not only is this excellent drainage system useful for ridding the oasis of surplus water, but it renders inestimable service in preventing the harmful accumulation of salts or "alkali." (See p. 36.)

SOILS OF THE JERID REGION.

TEXTURE.

As the soils of the Jerid region only were investigated, the discussion which follows relates only to that group of oases. All samples for analysis were collected at Tozer, but the composition of the soils of the other three oases is probably similar, except that those of Nefta apparently contain a higher percentage of sand. The date palm is said to grow most rapidly and vigorously in the soils that are richest in clay, although yielding a better quality of fruit in the sandier soils.

The following table gives the results of mechanical analyses of the samples taken, as furnished by the Bureau of Soils. Descriptions of the localities where each sample was obtained will be found in Table 11, on page 37, under corresponding numbers.

TABLE 9.—*Mechanical analyses of soils of Tozer oasis.*

Number of sample.	Depth of sample.	Character of soil.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
	Inches.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	0 to 36	Fine sandy clay, water at 36 inches depth.	0.3	4.0	4.0	17.6	23.1	13.0	38.6
2	0 to 36	Heavy, fine sandy loam, changes to blue clay near bottom of boring, water at 24 inches depth.	.9	6.3	6.5	22.1	36.1	7.8	20.5
3	0 to 24	Fine sandy clay, water at 12 inches depth.	.3	4.7	4.6	25.2	26.2	8.6	30.6
4	0 to 36	Fine sandy clay, water at 36 inches depth.	.3	3.2	3.7	19.4	25.8	11.2	36.4
5	0 to 36	Light, fine sandy clay	.5	4.5	5.3	19.7	34.3	6.9	28.7
6	36 to 72	Subsoil of No. 5, sandy clay, water at 60 inches depth.	1.4	5.2	5.4	21.1	32.5	5.3	26.9

It will be seen from the above analyses that the typical soil of Tozer oasis is a mixture of fine sand and clay, chiefly remarkable for its small percentage of silt. Soils of this type occur also in the Oued Rirh oases of Algeria. According to Dr. L. J. Briggs, they are seldom found (as soils) in the United States, although subsoils of similar composition are sometimes met with in the Atlantic Coastal Plain. In the field these soils do not impress one as being particularly heavy, notwithstanding the large amounts of clay they contain. The discrepancy is probably to be explained by the fact that they contain great quantities of lime in the form of calcium carbonate and of gypsum, calcium sulphate. (See Tables 11 and 12.) These salts have a tendency to cement the fine particles of clay into masses that imitate grains of sand and make the soil appear of coarser texture than it is found to be when examined in the laboratory. In the process of mechanical analysis much of the lime is dissolved and the fine clay particles fall apart. Furthermore, most of the relatively insoluble lime is probably classified as "clay" in computing the results of the mechanical analysis. A similar discrepancy between field observations and laboratory analysis was noted by Mr. Thomas H. Means and accounted for in this way in the case of soils from the Oued Rirh oases in Algeria.[a]

---

[a] See Bul. 80, Bureau of Plant Industry, pp. 41, 42 (1905). Many of the samples described in the table on page 42 of that bulletin show a mechanical composition very similar to the samples from Tozer.

In well-cultivated gardens the upper few inches of the soil contain a considerable amount of humus and are quite black in color, as would be expected from the fact that not only date palms and other fruit trees, but garden vegetables, forage crops, and cereals have been grown in the oases, probably without intermission, for many hundreds of years.

FERTILITY.

As to the composition of the soils of this oasis, so far as the important elements of plant food are concerned, the following table of a chemical analysis by acid digestion will furnish an indication:

TABLE 10.—*Plant food constituents of soils of Tozer oasis.*

	Per cent.
Nitrogen (total)	0.03
Lime (CaO)	13.08
Potash (K_2O)	1.10
Phosphoric acid (P_2O_5)	.14

The sample (No. 2 of Tables 9 and 11) was taken to a depth of 36 inches in a well-cultivated garden of young Deglet Noor palms, amid a thin, newly planted stand of alfalfa, and contained only a moderate amount of readily soluble "alkali" salts, as will be seen by reference to column 4 of Table 11.

If it be permissible to generalize upon the scanty data given above, it can be said that the soils of Tozer are decidedly low in nitrogen. When we consider that these soils are continually and lavishly irrigated with water that contains very little organic matter, that manure is scarce, and that leguminous crops occupy at no time more than a small fraction of the total area of the oasis, the poverty of the soil in nitrogen is not remarkable. If the analysis had been based only upon the surface 6 inches, a much better showing in this respect would doubtless have been made. Lime is present in much larger quantity than is usually considered necessary in the average cultivated soil. Potash, likewise, is present in far more than the usual proportions. Finally, the phosphoric-acid content is such as would generally be considered satisfactory.

According to the conventional standards the soils of Tozer would therefore be in all respects first-class, so far as plant-food constituents are concerned, were it not for their low nitrogen content. It would seem that to remedy this deficiency the growing of berseem (Egyptian clover) should be undertaken, as this crop ought to thrive in the Jerid region, with its mild winter climate and abundance of irrigating water.

ALKALI.

Where the gardens are well cared for and receive frequent irrigations, the soils contain very little readily soluble salts, and no trace of saline efflorescence is to be seen. But in neglected parts of the oasis, and especially in the low-lying lands situated near the Shott Jerid, the ground is often covered with a glistening white crust of salt, often to a depth of half an inch or more. Throughout the oasis one sees pieces of land that have been left for several years without irrigation, although surrounded on all sides by well-cared-for gardens. While the soil of the gardens only a few rods distant does not contain a large amount of readily soluble salts, the surface of the abandoned tract is usually covered with a white efflorescence, and bears a scattered vegetation of fleshy-stemmed "pickle weeds" or other salt-loving plants and an occasional small, stunted date palm. (Pl. II, fig. 1.)

Obviously all that is needed to rid the soil of such tracts of its excess of salts and to render it in all respects suitable for cultivation is the construction of drains, coupled with abundant irrigation. The soils are light enough and their slope is sufficient to render it an easy matter to wash out the salt in a short time. This the natives thoroughly appreciate. The writer saw several long-neglected gardens at Tozer that were in process of reclamation. In commencing operations the ground is worked over to a depth of 3 feet (Pl. II, fig. 2), and in case a heavy crust of salt has accumulated this is frequently scraped off and carted away. The latter operation is unnecessary, although doubtless helping to shorten the period of reclamation. Nowhere in the Jerid does there appear to be the least difficulty in reclaiming salt land if this method of flooding is followed. At Nefta, especially in the part of the oasis nearest the shott, new gardens of date palms are being established in land that is white with salt (Pl. VII, fig. 2). The natives agree that this can be removed very rapidly and completely if proper methods are used.

In the following table are presented the results of chemical analyses of soil samples taken in different parts of the oasis of Tozer, the first six numbers being identical with those in the table of mechanical analyses on page 34.

TABLE 11.—*Chemical composition of soils of Tozer oasis.*

No. of sample.	Description of locality where sample was taken.	Depth of sample.	Percentages of water-soluble components based on dry weight of soil.		Percentage of calcium carbonate based on dry weight of soil by acid digestion.
			Calculated from electrical resistance of saturated soil.	By chemical analysis of solution in 20 parts water to 1 part soil.	
		Inches.			
1	Open ground, surrounded by date gardens, much white saline efflorescence on surface; growth of salt-loving weeds	0 to 36	2.90	6.58	14.29
2	In garden adjoining No. 1, among young, thrifty Deglet Noor palms planted the year before in a thin stand of alfalfa	0 to 36	.54	5.33	12.84
3	In land, recently broken up for reclamation, of a neglected garden where palms had suffered from lack of irrigation	0 to 24	.20	4.82	10.24
4	In land still uncleared and covered with a dense growth of weeds and grass, in same garden as No. 3	0 to 36	.30	5.37	16.32
5	In unirrigated land lying higher than surrounding gardens; heavy efflorescence; scattered, stunted palms; growth of salt-loving weeds	0 to 36	.58	3.99	13.73
6	Same boring as No. 5, lower depth	36 to 72	.96	5.78	11.95
7	In garden among young Deglet Noor palms and a good stand of alfalfa; water at 36 inches	0 to 36	.2		
8	In unirrigated land outside garden in which No. 7 was taken, amid a growth of salt-loving grass and rushes; water at 24 inches	0 to 36	.97		
9	Saline crust from neighborhood of main drainage ditch; very little vegetation	0 to 1		54.1	5.39

The following table gives the composition of the totals of water-soluble salts, of which the percentages, based on dry weight of soil, are given in column 5 of the preceding table:

TABLE 12.—*Composition of water-soluble salts in soils of Tozer oasis.*

Number of sample.	Constituents, by analysis.							
	Ca.	Mg.	Na.	K.	SO_4.	Cl.	HCO_3.	PO_4.
1	18.49	3.31	6.53	2.22	54.95	13.23	1.27	Tr.
2	25.19	1.50	.34	2.84	65.97	2.36	1.80	Tr.
3	21.19	.83	4.81	3.86	67.56	Tr.	1.75	Tr.
4	21.34	1.12	3.76	4.81	65.61	1.57	1.79	Tr.
5	24.71	2.10	1.00	1.65	63.23	4.90	2.41	Tr.
6	24.78	1.55	.62	3.18	64.83	3.38	1.66	Tr.
9	3.39	4.70	21.36	2.41	50.63	17.17	.34	Tr.

Number of sample.	Conventional combinations, calculated.								
	$CaSO_4$.	$MgSO_4$.	$MgCl_2$.	KCl.	K_2SO_4.	$KHCO_3$.	$NaHCC_3$.	NaCl.	Na_2SO_4.
1	62.82	13.29	2.49	4.22			1.73	15.45	
2	85.57	7.05	.30	4.46		1.31	1.31		
3	71.99	4.11			8.59		2.37		12.94
4	72.51	5.32			10.71		2.46	2.56	6.44
5	83.92	5.01	4.31	3.15			3.31	.30	
6	84.20	6.81	.66	6.05			2.28		
9	11.52	23.27		4.59			.47	24.73	35.42

Upon examination of the data given in Table 11, a striking discrepancy is seen to exist between the percentages of water-soluble components to dry weight of soil, as stated in columns 4 and 5, respectively. By reference to Table 12, however, the explanation is found to be simple. In taking the electrical resistance of the sample, the soil was mixed with just a sufficient quantity of distilled water to bring it to the point of saturation, which in soils of this texture was found to be about 30 per cent of the dry weight of the soil; and the reading is taken as soon as the soil and water are thoroughly mixed. In making the chemical analyses, on the other hand, one part of soil is digested in 20 parts of water, and the mixture is allowed to stand twenty-four hours to bring it to an equilibrium before it is filtered.[a] By the second method the soil is in contact with from 60 to 100 times as much water as by the first method, and for nearly 288 times as long. Consequently a great amount of calcium sulphate goes into solution when the soil is prepared for chemical analysis that remains in the solid state and is hence unaccounted for in the samples as made up for a test of electrical resistance. By reference to column 2 of Table 12 it is seen that (except in sample 9) calcium sulphate amounts to from 60 to 85 per cent of the total water-soluble matter, of which only an insignificant fraction can be dissolved in the amount of water and with the limited time allowed for taking the electrical resistance.

It should be said in this connection that experiments have shown a saturated, pure solution of calcium sulphate to be harmless and even beneficial to plants, and that an excess of calcium sulphate in the presence of magnesium and sodium salts has an extraordinary influence in modifying the toxic action of the latter.[b] The calculations of water-soluble contents of the soil based upon the electrical resistance, although confessedly only rough approximations, are of some value as indicating the amount of the readily soluble and actually harmful saline contents of the soil. On the other hand, they do not include the gypsum or calcium sulphate that is present, and thus do not tell the whole story. If the latter were merely neutral, it could simply be deducted from the total salts as ascertained by chemical analysis; but as it plays an important part in counteracting the effect of the sodium and magnesium salts, its presence can not be ignored.

---

[a] For a description of the methods used, see Cameron in Bul. 18, Bureau of Soils, U. S. Dept. of Agriculture, pp. 66 and 67. For a discussion at some length of the significance of the high gypsum content of these soils, see W. T. Swingle, Bul. 53, Bureau of Plant Industry, pp. 73 and 74.

[b] Compare Kearney and Cameron in Report No. 71, U. S. Dept. of Agriculture, p. 39.

Turning to Table 12, let us compare the different samples as to their chemical composition. We notice at once that sulphuric acid is the acid and calcium the base which largely predominate in all of them, excepting sample No. 9. The latter, consisting of the efflorescence that is brought out on the surface of the soil by the combined action of capillarity and evaporation, is necessarily deficient in the slightly soluble calcium salts.[a] In the crust, as well as in the soils, however, sulphuric acid is by far the most important constituent. We may therefore regard the "alkali" of Tozer oasis as of the sulphate type.[b]

Free carbonates were not detected by the phenolphthalein test, either in the field or in the laboratory, except in the crust (sample No. 9), in which a very faint alkaline reaction was observed upon testing the freshly collected sample. In all other cases the reaction was neutral, not only at the time the samples were collected, but four months afterwards when examined in the laboratory. "Black alkali," therefore, apparently does not exist in Tozer oasis. The high percentages of calcium carbonate obtained by acid digestion of the soils (see column 6 of Table 11) would suggest the possibility of its formation under certain conditions were it not for the relatively small amount of sodium and the great quantity of calcium and sulphuric acid present.

The percentages of potassium and of carbonic acid differ comparatively little in the different samples, while those of sodium and of hydrochloric acid show very considerable variation. The relatively small part played by hydrochloric acid is surprising, when we consider that in the adjacent Shott Jerid mines of table salt exist. The smooth crust of salt that covers the bottom of the shott has the appearance of containing a higher percentage of sodium chlorid than do the efflorescences upon the soils of the oases, the latter being of the fluffy, powdery aspect which the presence of a large amount of sulphates generally produces.

It is interesting to note the difference in composition between the efflorescence (sample No. 9) and the soil solutions (samples Nos. 1 to 6). In addition to the very small percentage of calcium in the crust, as compared with the soil samples, we remark in the crust a considerably higher percentage of magnesium, a very much higher percentage of sodium and of hydrochloric acid, and a much lower percentage of carbonic acid. In respect to potash and sulphuric acid the difference is not noteworthy.

---

[a] In discussing "alkali" soils of Utah, Gardner and Jensen (Field Operations of the Division of Soils for 1900, p. 231) remark: "Lime is always present in the soil alkali in appreciable amounts, whereas in the crusts it is usually absent."

[b] In the soils of the Oued Rirh oases, in Algeria, also, sulphates generally predominate over chlorids, although the converse is frequently true. (See Bul. 53, Bureau of Plant Industry, p. 96; and Bul. 80, Bureau of Plant Industry, p. 46.)

It remains to consider the composition of the drainage water. A sample was taken from the "Khandak-el-Kebir," the main drainage ditch of the oasis of Tozer (see p. 33), at a point some distance beyond the last garden toward the shott. This sample, like that of the irrigation water described on page 30, after having been kept for two months in a rubber-stoppered bottle, remained perfectly sweet and good. Tested with phenolphthalein as soon as it was collected, the water showed a very faint pinkish opalescence, indicating a slight trace of free carbonates. An analysis of this sample in the laboratories of the Bureau of Soils showed the presence of 530.4 parts of salts per 100,000 of water, which is a little more than two and one-half times the amount found in the irrigating water (see p. 30). Water of this concentration could be safely used in irrigating many crops,[a] and considering the fact that the drains penetrate everywhere, and that the sample was collected at a season (February 5) when comparatively little irrigation is going on, its relatively small salt content indicates that the soils of the oasis generally are not highly saline.

TABLE 13.—*Chemical composition of drainage water, Tozer oasis.*

Percentages of different constituents.		Conventional combinations.	
Calcium	9.97	Calcium sulphate	33.88
Magnesium	5.30	Magnesium sulphate	16.54
Sodium	8.67	Potassium chlorid	16.70
Potassium	8.77	Magnesium chlorid	7.69
Sulphions	37.11	Sodium chlorid	14.80
Chlorions	22.64	Sodium bicarbonate	10.39
Carbonic acid	7.54		100.00
	100.00		

Comparing the percentage composition of the saline matters in the drainage water with that of the irrigation water, we find a remarkably close agreement. As compared with the soil samples (Nos. 1 to 6 in Table 12), the drainage water contains relatively much more magnesium, sodium, and potassium and very much less calcium. In respect to acid constituents there is relatively much less sulphuric acid and much more hydrochloric and carbonic acids. In comparison with the salt crust, of which a sample was taken near the spot where the water sample was collected (sample 9 in Table 12), the drainage water contains relatively much more calcium, potassium, and carbonic acid and considerably more hydrochloric acid. On the other hand, it is much poorer in sodium and is considerably poorer in sulphuric acid than is the crust.

---

[a] See T. H. Means, Circ. 10, Bureau of Soils; and Bul. 80, Bureau of Plant Industry, p. 38.

When we consider the great predominance of calcium sulphate and the absence of easily soluble carbonates ("black alkali") in the soils of Tozer oasis, it is apparent that the type of "alkali" occurring there is a relatively harmless one. In view of the relatively small percentages of readily soluble salts, as indicated by the electrical resistances of the soils of well-kept gardens, and taking into account the thorough drainage system of the oasis, the "alkali" problem can not be regarded as a very serious one in this region.

CULTURE OF THE DATE PALM.

As the gardens of the Jerid only were investigated in any detail, the following notes relate principally to that region, although most of the observations are doubtless equally applicable to the other oases of southern Tunis. Cultural methods could not be given the thorough investigation the subject warrants, the writer's time having been mainly taken up in studying the characters of the different varieties and in getting together the collection of offshoots for shipment to the United States. Yet it is thought that some of the information obtained will offer useful suggestions to future date growers in this country. The following discussion is based partly upon notes obligingly furnished by M. Minangoin, inspector of agriculture at Tunis, and upon the published paper of M. Masselot,[a] and partly upon data obtained by observation and by questioning the inhabitants. In regard to the latter source of information, it should be said that while the cultural methods used by the Arabs appear to have generally a common-sense foundation, the reasons which they give for their practices are often extremely childish. As a rule, they follow slavishly the precepts that have been handed down to them by wiser ancestors, without concerning themselves about why they do this or that. Yet, occasionally one meets an intelligent native who can give a rational explanation of most of his proceedings.

SIZE AND VALUE OF THE GARDENS.

The size of the date gardens varies greatly. The largest in the Jerid is said to be that of Dobech, at Nefta, in which there are 2,800 palms. The writer was told that the annual revenue from this garden is from $4,500 to $5,000. At Tozer the largest garden, that known as "Mahaleb," is said to yield the owner $3,400 a year. The garden of Tishta, at Nefta, is remarkable for the large number of varieties it contains. It was formerly the property of a caid, whose hobby it was to collect as many different sorts as possible. Practically all of the gardens in the Jerid belong to natives. French capital has not been engaged here, as in the Oued Rirh oases of Algeria, in establishing plantations of date palms.

---

[a] Les Dattiers des Oasis du Djérid. Bul. Dir. Agr. et Com., Tunis, 1901, pp. 114–161.

According to official estimates there should be about 96 trees to the acre in the gardens of Tozer, but in reality they are much more densely crowded, only taxable palms, i. e., those in full bearing, being enumerated by the census takers. As many proprietors estimate the value of their gardens at the rate of $19 per tree in full bearing, an acre containing 96 date palms in good condition would be worth $1,824. But since the value of a palm depends largely upon the variety to which it belongs, and as most of the gardens contain many trees of inferior varieties mixed with the better sorts, it is probable that the figure mentioned is too high as an average for the whole region. On the other hand, an acre of Deglet Noor palms in full bearing would doubtless be worth even more; but there are very few gardens in the Tunis oases in which the Deglet Noor variety constitutes even one-half of the total number of trees. At Nefta, according to official estimates, the average number of trees per acre is 125, while in the neglected oasis of El Hamma it is only from 62 to 75.

Each garden is surrounded by a "tabia," or wall of mud, surmounted by a palisade of palm leaves, the whole being generally 5 or 6 feet high.

LABOR AND TENANTRY SYSTEM.

Labor is abundant and very cheap in that part of the world. The inhabitants of the oases, having devoted themselves for many centuries to the culture of the date palm, are thoroughly familiar with every detail of it, although the great majority of them carry on the necessary operations instinctively rather than intelligently. For the ordinary work of the gardens an abundance of labor is available; but for operations demanding especial skill, such as detaching suckers for planting, pollinating the flower clusters, and gathering the fruits of the best varieties, experts are required, and these are much less numerous.

At Nefta and at El Oudiane many of the owners manage their own gardens, while others employ a tenant, or "khammes." At Tozer the latter system is all but universal, and in consequence the gardens are often less well kept. The khammes is so-called from the fact that he is supposed to receive one-fifth of the product of the gardens, khammes being the Arabic word for "fifth." As a matter of fact, this manner of payment no longer obtains in the Jerid. Nowadays the khammes is entitled to one-eighth of the yield of trees of all varieties, except the Deglet Noor, and to one bunch of fruit from each ten trees of the latter kind. In addition, he is permitted to raise vegetables, forage crops, and grain in the gardens (Pl. VII, fig. 2) and he is allowed as much as he wishes of these products for his own use, besides one-fourth of the proceeds of what is sold.

In return, the khammes is expected not only to carry on all the work of the garden—irrigation, cultivation, manuring, pollinating the female flower clusters, etc.—and to keep in repair the ditches for irrigation (seguias) and those for drainage (khandaks), as well as the walls (tabias), but, when he has any spare time, to do domestic service for the proprietor. During the season when the fruit is ripening and needs to be guarded night and day to prevent its being stolen the khammes and his sons often camp in the garden, inhabiting a small tent or even sleeping in the open. At other times the gardeners and their families live in the towns, going each morning afoot or on donkey back to their work. There are no permanent habitations among the gardens, as the towns, being situated on higher, dry land (Pl. VI, fig. 3), are considered healthier. Even under these circumstances, however, the population of the Jerid is ravaged in summer and early autumn by malaria. The population, as a whole, is anemic, feeble, and subject to various diseases, notwithstanding the fine winter climate.

PROPAGATION.

In Tunis, as elsewhere in the Sahara, the date palm is intentionally propagated only by means of the offshoots that spring from the base of the trunk (Pl. V), which, in well-cared-for gardens, are taken only from trees belonging to good varieties and known for the quality of their fruit. But in neglected gardens and in waste ground many seedlings ("el hachana") spring up fortuitously, and in this way doubtless the many varieties have arisen. Seedling palms are, of course, rarely true to type, although the writer was gravely assured by an intelligent Arab that to make them come true it is only necessary to transplant them two or three times, and that this method is sometimes resorted to when suckers are not procurable, in order to perpetuate very rare varieties!

Manuring and watering freely are said to stimulate suckering, and the construction of a "dokana," or circular mound of earth and clay[a] (Pl. V, fig. 2), around the base of the palm is a good way to obtain strong, well-rooted offshoots. If an offshoot starts from the trunk some distance above the surface of the soil it can be made to take root by cutting away the outer leaves and fastening a basket filled with earth around its base. Offshoots produced by palms growing in open places, unshaded by other trees, are considered to give the best results.[a] Some of the inhabitants of the Jerid are of the opinion that offshoots developed in unirrigated and salty land make more vigorous palms than those grown in well-tended, frequently irrigated gardens. It is possible, at least, that such offshoots are hardier at the start and are less likely to perish in the early stages of growth.

---

[a] Illustrated also in Bul. 86, Bureau of Plant Industry, Pl. V, fig. 1.

The offshoots are generally of sufficient size to transplant when two or three years old, but they must not be taken up until they are well rooted. The natives say they are of the best size for planting when about as large as a camel's head at the base, but while still without a well-formed trunk above ground. One offshoot is generally left attached to each palm when the others are removed, in order to replace it when it dies or becomes unproductive. When this in turn produces offshoots, one of these is retained, and so on. Hence it is not unusual to see trunks belonging to several generations all still attached to the same parent stock. (Pl. V, fig. 2.) It must be remembered that a date palm generally ceases to sucker after it is 10 to 15 years old.

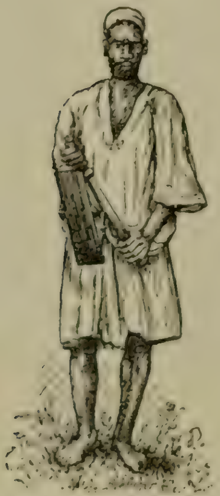


FIG. 3.—Laborer holding a "messah," or short-handled hoe.

The price paid for offshoots in the Jerid depends upon the variety, Deglet Noor offshoots selling for from 57 to 75 cents apiece, while those of most other varieties cost only from 19 to 57 cents.

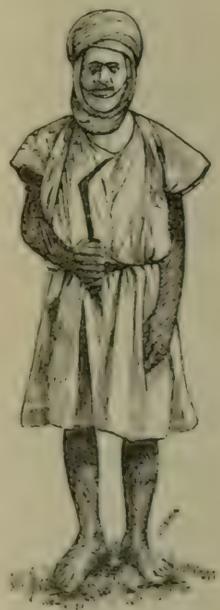


FIG. 4.—Date picker holding a "mengel," or straight-bladed sickle, used for cutting off the bunches of dates.

Considerable skill is required in detaching the offshoots from the parent stem. First, all but the innermost leaves are cut off near the base, and those that are left are often fastened together with a shred of palm leaf, to prevent their being broken during the operations. Next, a hole of some size is dug around the offshoot with a pick or with the "messah," a short-handled hoe. This tool (fig. 3 and Pl. II, fig. 2) is quite unlike the Egyptian "fass,"[b] having a much larger, shovel-like blade, with the handle so attached as to be nearly parallel with the blade instead of at right angles to it. At the same time all the roots that can be reached are cut off close to the base by means of a "mengel," a tool with the shank and blade made in one piece of wrought iron and fitted with a wooden handle. It somewhat resembles a sickle, but has a straight, heavy, saw-edged blade nearly at right angles to the shank (fig. 4). One man then grasps the offshoot and pulls down on it, while another, armed with a chisel or a pick, pries it loose at its point of junction with the parent tree. The remaining roots are now cut off, and the sucker is ready to be planted. The cost of thus removing a sucker is generally 6 cents.

---

[a] The belief among the natives is that an offshoot must receive plenty of moonlight in order to become a strong palm!

[b] Illustrated in Bul. 130, Office of Experiment Stations, U. S. Dept. of Agriculture, 1903, p. 39.

If the offshoot is to be transported a considerable distance before it is planted, it must be protected from drying by a wrapping of the coarse fiber (leef) that invests the bases of the leaf stalks of the date palm (fig. 5) or of some similar material.

PREPARING THE LAND.

The methods used in preparing the soil, especially if it contains "alkali," are essentially the same whether the plantation is to be made in new land or in an old garden that has been neglected. First, the irrigation and drainage ditches are dug or are cleaned out. Next, the soil is worked thoroughly to a depth of 3 to 6 feet with the short-handled hoe, or messah, this operation being accomplished by digging a trench of the required depth at one side of the garden and then working across. All stones, masses of gypsum, etc., encountered are carefully removed. The whole garden is then flooded to wash out whatever salt has accumulated near the surface of the soil. When that is accomplished, in order to facilitate irrigation the garden is divided up into "lands" that vary greatly in size, but rarely exceed 120 square yards (1 are). A donkey load of manure, carefully freed from straw, is frequently worked into the soil of each "land." Often, during the next two or three years, only vegetables, especially turnips, cabbage, and carrots, are grown before date palms are planted. It costs 14¼ cents to dig 15 feet of drainage ditch of the ordinary depth (5 feet), and from 4¾ to 13 cents annually to keep the same length in repair. Breaking up the ground with a messah costs from 28½ to $1.25 per 20 square feet, according to the depth of the hoeing and the character of the land.

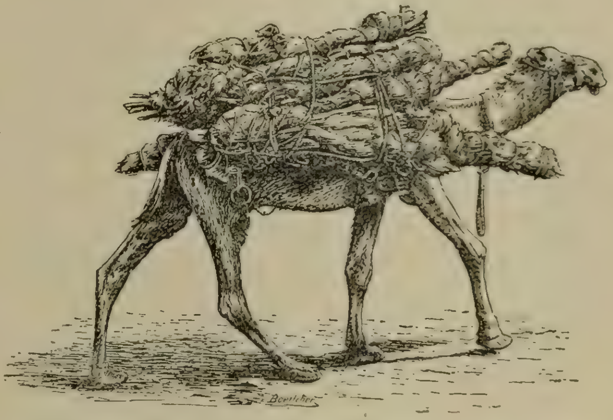


FIG. 5.—Camel carrying date offshoots wrapped in palm fiber (leef) for transportation.

PLANTING.

Planting is done in the Jerid during the months of March to June. It is said that in well-drained soils it can be begun with safety as early as March 1, but in very wet land must be postponed until a month later. At Gabes the amins say that if offshoots are detached in March, after the sap has begun to flow freely in the palm, the chances of their growing are better than if taken earlier, although they can be removed with little risk as early as February 15.

In the newer gardens of the Jerid the palms are generally set in with some attempt at alignment (Pl. VII, fig. 2) at intervals of 15 to 30 feet each way, 30 feet being recognized as quite sufficient for obtaining the maximum yields.[a] In the older gardens, as pointed out above, the trees stand at very irregular intervals and are often much crowded (Pls. I and IV, fig. 2). The holes made to receive the offshoots are usually 3½ feet in diameter and about 1½ feet deep in new land, while in replacing an old or diseased palm the hole is made 3 to 6 feet deep, probably in order that as much as possible of the old soil may be removed. The hole is then filled with well-washed sand, which is trodden down firmly around the base of the offshoot as soon as it is set in and again after the first irrigation.

A practice that is highly recommended, particularly in gardens where the water table is high, is that of placing stones in the bottom of the hole so as to support the base of the offshoot, thus insuring good drainage. This custom has fallen into disuse in the Jerid, but when old trees are dug up there it is said that stones are frequently found among their roots. The practice still prevails in the Mzab oases of Algeria.[b]

It frequently happens that the offshoot is more or less curved. To make it develop into a straight palm, it is recommended to plant it with the concave side facing southeast, "like a man saying his prayers," as the Arabs express it. The young palm, thus receiving more of the sun's rays on its concave than on its convex side, gradually becomes straight.[c]

---

[a] There is a proverb current among the inhabitants of the Mzab oases in Algeria (quoted by Charlet, Les Palmiers du Mzab, Bul. Soc. Géogr. d'Alger, 1905) to the effect that "If one plants at 30 cubits, one has dates without trouble; if one plants at 20 cubits, one has them only by taking great pains; but if one plants at 10 cubits, it is labor wasted."

[b] Charlet, Les Palmiers du Mzab, Bul. Soc. Géogr. d'Alger, 1905.

[c] The same practice occurs in the Mzab oases, according to Charlet (Bul. Soc. Géogr. d'Alger, 1905). This author makes the interesting statement that suckers sometimes finally grow that have shown no sign of life for one and one-half to two years after being planted. The natives say that growth can sometimes be started in such a case by transplanting to another part of the garden. They believe that the offshoot had willfully refused to grow in its first station on account of the dislike it had taken to some neighboring palm.

The cost of planting a palm is about 2½ cents, but in already established gardens the work of replacing old or diseased palms is part of the regular duties of the khammes, or tenant, for which he receives no extra compensation.

The young palm is usually sheltered by a tentlike covering of date palm leaves (Pl. II, fig. 2), until it is strong enough to face without protection the summer sun and the cold winds of winter. The shelter is generally left in place for a year, i. e., until the spring after the planting. Where palms are planted on the edge of an oasis, and hence beyond the shelter of older trees, "tabias," or palisades, to break the force of the sand-bearing winds (see p. 14), are often erected at intervals of 30 to 50 feet in the young plantation. It is estimated in the Jerid that from 10 to 15 per cent of the suckers planted fail to grow.

IRRIGATING.

As soon as the offshoot is planted a shallow basin is made around its base, in order to hold the irrigating water. Care is taken to construct this so that the water can not come in contact with the terminal bud, or "heart," of the young palm. During the first forty days after planting, many of the natives consider it preferable to water palms by hand from a water jar, at the rate of 4 gallons for each palm daily, rather than by flooding. It costs about 20 cents to water 30 palms daily in this way. After forty days two waterings a week are generally sufficient. At Nefta the growers told the writer that the practice is to water palms, until they are one year old, every day in summer, every four days in spring, and every eight days in autumn. If irrigated by flooding, two irrigations a week are generally sufficient, at least after the first few weeks, and two a month in rainy seasons, e. g., in autumn.

For older palms irrigation by flooding small basins, each containing several palms, is the only method practiced. One irrigation a week is generally sufficient, although a marked increase in yield is said to be obtained by irrigating twice a week. But many proprietors of gardens at Tozer, having disposed of part of their water right, get water only once or twice a month. According to an estimate made by M. Minangoin, water is ordinarily put on the land to a depth of about 2½ inches, of which nearly 1 inch is almost immediately absorbed by the soil. M. Masselot, however, states that the "lands" are flooded to a depth of about 4 inches at each irrigation. The amount of water theoretically available for each palm in the oasis of Tozer is variously estimated at from 42 to 62½ gallons daily. (Compare p. 29.)

Irrigation is most urgently required during the hot, dry months of June, July, and August, when the fruit is developing, and again in

November and December, after the harvest, the trees being at that time particularly weak and in need of stimulation. Irrigation throughout the winter is regarded as an excellent practice, as it stores the soil with water and makes it possible to get along with a smaller amount when the hot weather first begins. Land that is left entirely without water during the winter is said to become so dry that the first irrigations in summer can only wet the soil to a slight depth and the trees suffer from lack of water at the very time they need it most. In winter, however, irrigations are given much less frequently than at other seasons. It is said to be customary in winter to flood the whole garden at once, rather than to turn the water into small basins one at a time. Nor is so large a quantity of water necessary at each application, as it is not thought well to let the water stand on the land for any considerable length of time in winter, and the evaporation is naturally much less than in summer. Judging by the height of the ground water in the gardens of Tozer in midwinter (February 5), it would appear that the soils of the oasis are always in a very wet condition. Compare column 3 in Table 9, page 34.

No water should be applied for two or three weeks after the pollination of the female flower clusters in spring, as irrigation at that season causes the newly set fruit to drop off. Nor is it advisable to irrigate in the autumn for three or four weeks preceding the harvest, as otherwise the ripening fruit falls or else becomes so juicy that it molds easily and can not be preserved. Many gardeners withhold water from their palms from about the 1st of October until the dates are gathered.[a]

It has been pointed out in discussing the character of the drainage water (see p. 40) that this is not too saline for irrigation purposes. As a matter of fact, some of the gardens at Tozer lying nearest the Shott Jerid, and hence in the lowest part of the oasis, are irrigated solely with water from the drains. It is true that the palms are less thrifty and the yields obtained are smaller than elsewhere, but this is at least partly attributable to the poorer quality of the soils in that quarter and to the fact that in summer, when water is most needed, the drains are frequently empty.

---

[a] Charlet (Bul. Soc. Géogr. d'Alger, 1905) mentions that the same rule in regard to spring and fall irrigation obtains in the Mzab oases, where the application of water ceases about September 15, to be resumed after the harvest is completed.

MANURING.[a]

The continual irrigation of the oases and the small extent to which leguminous crops are grown among the palms are probably responsible for the low nitrogen content of the soil, as shown by the analysis on page 35. As far as possible the natives seek to remedy this deficiency by manuring. Unfortunately, owing to the small number of domestic animals kept, the supply of stable manure is very limited and the use of chemical fertilizers is as yet unknown.

No manure is given to the young palms when first set out, although where garden vegetables are grown in new land that is being prepared for a date orchard, as shown on page 45, the suckers doubtless receive some benefit from the manure that had been applied to the vegetables during the two or three preceding years. When the palm is 3 years old and is beginning to sucker it is manured directly for the first time. A circular trench is dug around the tree, at least 3 feet from its base. This is filled with one part of manure to two parts of earth, thoroughly mixed together. Frequently only one-half of the trench is dug and filled the first year, the circle being completed the year following. Subsequently the palm is usually manured only every four years, although some gardeners prefer to give a smaller application every year.

In the case of older palms the manure is spread on the surface and then worked into the ground, being applied at the rate of one donkey load to each tract of 7 square yards. Strong soils, containing a high percentage of clay or of organic matter and gypsum, are manured less heavily than the light sandy soils. Where garden vegetables are grown among the palms and manured every year the palms themselves receive no separate application. The best time to manure date palms is considered in the Jerid to be from October to January.[b]

Only thoroughly rotted manure that is at least one year old can safely be used. The natives recognize it as one of the advantages of old manure that it contains fewer viable weed seeds. Grass and straw are carefully removed before the manure is applied. The inhabitants differ as to what kind of manure gives the most satisfactory results with the date palm, some advocating that of camels, others that of donkeys.[a] But the total supply is too limited to allow of much choice in this respect, and every source is drawn upon, even to the scrapings of chicken yards and the refuse from human habitations.

---

[a] For the practices in this regard in the Oued Souf, see Bul. 86, Bureau of Plant Industry, pp. 22–24.

[b] According to Charlet (Bul. Soc. Géogr. d'Alger, 1905), many of the inhabitants of the Mazb manure their palms every year, sometimes at the beginning of winter and sometimes in February when the sap begins to run. This author estimates 44 pounds of manure as the quantity needed annually by each palm. In the Oued Souf (Bul. 86, Bureau of Plant Industry, p. 23) October and March are considered the best months for applying manure.

OTHER CULTURAL METHODS.

When the palm has reached the age of 2 years, the old leaves and leaf stalks are trimmed off for the first time, but not too close to the ground, as in that case no suckers will develop. On the other hand, if left on the trunk these parts decay and sometimes cause the central bud to rot. It is considered important to work the soil around the palms to a moderate depth in the second and again in the third year after planting. Thereafter the ground should be worked over as often as possible. All cultivation is laboriously done with the messah, or short-handled hoe (see Pl. II, fig. 2, and text fig. 3, p. 44).

It is considered advisable not to permit the development of the earliest fruit clusters (which sometimes appear when the tree is only 4 years old), as too early production diminishes the vigor of the palm. In regard to the choice of other fruit trees to be planted among the date palms, figs and olives, being relatively shallow rooting, are recommended in preference to apricots, the latter being deep-rooted trees that compete with the palms themselves.

POLLINATION AND MALE PALMS.

The operation of pollination, which was not witnessed by the writer, has been described from personal observation by Mr. W. T. Swingle.[b] It is said to take place in the Jerid usually from March 15 to April 15. Male palms are not distinguished there according to variety, but according to their time of flowering, whether early, intermediate, or late,[c] and also, it is said, according to whether they originate from seed or from suckers. As a rule, the male palms resemble each other much more closely than do the female palms belonging to different varieties. They are distinguished from female palms in general by more numerous leaves and leaflets (Pl. IV, fig. 2) and often by a stouter trunk. According to M. Minangoin, the leaf stalks of male palms are very stout and the foliage is fine and soft looking.

---

[a] One owner of a garden assured the writer that camel manure is "too strong" to be used in irrigated land, although it can be applied with perfect safety under the conditions prevailing in the Oued Souf.

[b] Bul. 53, Bureau of Plant Industry, pp. 26–29.

[c] Five suckers of each type of male palm, 15 in all, were imported into the United States from the Jerid.

In the Jerid oases, males constitute a very small proportion of the total number of palms. One male is said to furnish sufficient pollen for fecundating 500 to 600 females. In the most extensive garden of Tozer oasis the writer was shown an unusually large and fine male which he was told served not only for all of the fruiting palms in this garden, considerably more than 1,000, but for neighboring gardens as well. The flowers of male palms are said to be free to all who wish to use them, without compensation to the owner. The males are reputed to live longer than the females, but finally become so tall that it is difficult to gather the flower clusters. They then share the fate of female palms that have ceased to bear, the terminal bud being girdled in order to extract lagmi, or palm wine, an operation that sooner or later results in the death of the tree.

The writer saw, in February, a palm (illustrated in Pl. IV, fig. 2) which had all the characters of a male, as the tenant of the garden in which it grew declared it to be. Nevertheless, it bore clusters of small, seedless green dates, similar to the "sichi" (unfecundated) fruits of the Fteemy variety (see p. 70). Although the only case observed by him, this is apparently a rather well-known phenomenon.[a]

RIPENING.

The bunches of dates often become too heavy for the stalks that bear them. To prevent the breaking of the fruit stalks the clusters are therefore frequently "straddled" upon the nearest leafstalk, as shown in Plate III. This is an operation that requires considerable skill, and, in the case of choice varieties, is usually intrusted to an expert.

Much rain during the first few weeks after pollination is as injurious as irrigation at that season, causing the newly set fruit to drop. On the rare occasions when rain falls during the months of May, June, and July—that is to say, after the fruit has set and before it begins to ripen—it does no harm. During the early autumn, when the dates are maturing, hot, dry winds from the south and west are favorable, as they hasten the ripening process and prevent the fruit from becoming wormy. On the other hand, a heavy rain at this season is disastrous. If it falls in August or September it will cause the fruit to drop before maturity; if a little later, the fruit tends to rot or to become moldy. When the dates have become perfectly ripe a light rain is rather beneficial than otherwise, as it softens them and washes off the dust that has gathered on them. But a heavy rain causes the ripe fruit to sweat and, while not injuring its flavor, lessens its exportability. The relation between the late summer and autumn rainfall and the quality of the dates is brought out in Table 4, on page 25.

---

[a] J. W. Toumey (Bul. 29, Ariz. Exp. Sta., 1898) notes the fruiting of male date palms at Phoenix, Ariz., and at La Paz, Mexico. Charlet (Bul. Soc. Géogr. d'Alger, 1905), mentions the existence of two fruiting male palms in the Mzab oases.

To illustrate the opinion of the inhabitants of the Jerid concerning the effect of rain in early autumn upon their principal crop, the following anecdote, current among them, is related by Masselot:[a]

> Once upon a time, after several years of drought and at length of famine, the bey had ordered that public prayers for rain be said throughout the regency. The people of the Jerid, alone among his subjects, refused to obey the order of their sovereign. The latter, in anger, ordered the chief notables among the refractory inhabitants to come to Tunis to receive punishment, had them appear before him, and said to them: "How happens it that when I command public prayers in order to attract God's attention to us and bring us the blessed rain that will give wealth to our unhappy country, you alone should dare to disobey this order, given in the general interest?" "You have acted rightly," replied the chief men of the Jerid, "but so far as our country is concerned, rain would have been its ruin. Behold this soft and fragrant ball of honey. Add a little water to it and what does it become? A coarse, tasteless liquid. Such are our dates, which in order to produce their honey require many rays of the sun, but not a drop of rain." The bey was convinced, it is said, and permitted them to return to their homes.

It is said that Deglet Noor dates should not be gathered much before the end of October, as, no matter how perfect their condition seems to be, if harvested earlier they will discolor and become wormy within a few weeks. It was suggested by a date buyer at Tozer that by cutting about one-third way through the main stalk of the fruit cluster when the dates begin to mature, and thus shutting off part of the water that passes through the stalk, the fruits can be made to ripen earlier without injury to their keeping quality. The experiment is at least worth trying. It is said that Deglet Noor dates can also be ripened faster by removing the bunches when the dates begin to soften and hanging them up in dry rooms.

HARVESTING.

Different varieties of dates mature at different periods, the earliest in the Jerid commencing to ripen in August, or even toward the end of July, while the latest are not all ripe before December. Consequently the harvest goes on in this region during about five months. The gathering of the Deglet Noor dates is done with especial care, as they are the only kind that is exported in any quantity to Europe. The harvest of this variety begins in earnest toward the end of October (about October 25 in 1904) and often continues into the first days of January. Of course, all the fruit that will ripen has matured long before the latter date, but the skilled laborers required are not sufficiently numerous to gather all the fruit as soon as it is ready to harvest. Fortunately, this is one of the varieties the dates of which can be left on the palms without injury for several weeks after maturing, provided the autumn is a dry one.

---

[a] Bul. Dir. Agr. et Com., Tunis, 1901, pp. 122, 123.

The Deglet Noor crop is generally purchased on the trees and the harvest is supervised by the buyer or his agent. Bunches borne on small trees which can be reached from the ground are said to be preferred by the more wealthy natives for their own consumption, being less liable to injury in the harvesting. Palms in full bearing, however, are generally too tall to allow their fruit to be gathered thus easily. The harvest from such trees is a rather complicated matter, giving employment to a large number of men. (Pl. I, frontispiece.)

First there is the "getaa," whose work requires the most skill. Armed with a "mengel" (see fig. 4, p. 44) he climbs to the top of the palm, cuts away with a few deft strokes such of the dead leaves as hang in his way, and then proceeds to sever the stalks of the fruit bunches. Along the trunk below him a sort of human ladder has meanwhile been formed, the number of men and boys that compose it depending of course upon the height of the tree. The writer saw eight men besides the getaa clinging to one tall Deglet Noor palm. Supporting themselves with one arm around the trunk and grasping the scaly bark with their bare feet, they hand down the bunches from one to another as they are received from the getaa until the entire product of the tree is safely on the ground. The tree is thus stripped with wonderful celerity, to the accompaniment of a shower of the ripe fruits that become detached from the bunches.

The getaa receives from 38 to 57 cents per day for gathering Deglet Noor dates, while the "meddada," who pass the bunches down the trunk, are each paid 19 to 24 cents per day. Even after the dates reach the ground they are handled by a little army of men and boys, each of whom has some small duty in connection with the harvest.[a] Thus the "lagata" are occupied solely in picking up the detached dates that fall while the bunches are being cut and passed to the ground. Each of them is paid 12 to 15 cents a day. The "adal," whose duty it is to carry the bunches to the central point where the product of the whole garden is collected, are entitled to from 19 to 24 cents each. The "batah," or men who guard the heap of dates and the belongings of the workmen, receive the same wages. The "jerrara" transport the dates from the garden to the storehouse, and receive for each donkey load about 11 pounds of dates that have dropped off the bunches. Then there is the "alleg," who loads the animals for the "jerrara," and the "khartaf," who attaches cords to the bunches and brings them to the "alleg" and who also arranges the bunches upon beams in the storehouse where they are dried.

---

[a] It is said that the owners of gardens are held to be acquitted of their obligation as good Mohammedans to devote a tithe of their incomes to charity if they give employment during the date harvest to a sufficient number of the poor of the oasis.

It is said that one getaa can keep employed seven meddada, twelve lagata, two adal, six jerrara, one alleg, and one khartaf. In one day a skilled getaa can harvest the dates from 60 to 90 palms, according to the height of the trees. With the above-mentioned number of assistants of all classes, he can harvest on an average 5,500 pounds of dates daily.

Deglet Noor dates that are to be exported to Europe are often packed for shipment in the gardens where they are grown. A large part of the crop is put up in wooden boxes holding 22 pounds each, which is the maximum weight that can be sent by parcels post in a single package. (See Pl. I, Frontispiece.) They are then transported by caravan to the railway terminus, which is about 35 miles from Tozer.

The fruits of a few of the best varieties other than the Deglet Noor are harvested with the same degree of care. In the case of certain rare and highly esteemed sorts, especially of the earlier ripening varieties, the fruits are even picked one by one from the bunches as they mature. These are dates that are reserved for the tables of the wealthiest class of natives. But in harvesting by far the greatest number of varieties, including the popular Fteemy date, which constitutes probably more than one-half the total crop of the Jerid, the bunches, as they are cut by the getaa, are merely dropped upon mats spread on the ground underneath the palm, instead of being passed from hand to hand by the "meddada." In harvesting Fteemy dates the men are paid in kind. For each day's work the getaa is entitled to a bunch, which he selects among the finest, to two bunches of medium value, and to 11 pounds of detached fruit.[a] The other laborers are paid with a proportionate share of dates. For harvesting "khalt," or dry dates, the daily wage of the getaa is eight measures of fruit, amounting to about 88 pounds.

PRESERVING.

The fruits of the different varieties differ greatly in their keeping quality. Some must be eaten fresh, remaining edible at most only a few weeks after ripening. Certain kinds, including some that keep very well when ripe, are nevertheless preferred by the natives when in the "besser" stage; that is, before they are perfectly soft and ripe. These have the peculiarity of losing their astringency before they become very soft. Some kinds, both of soft and of dry dates, can be preserved several years without spoiling, although dry dates are apt to become excessively hard when kept for a long time. Soft, sirupy dates of good keeping quality, such as the Rhars and the Lagoo, are preserved in earthenware jars or in skin bags. The finer sorts, such as the Deglet Noor, are often hung up in bunches in the houses of the natives, and are picked off or else served on the branch as wanted.

---

[a] According to Masselot (ibid., p. 124), the total value of this quantity of fruit would be about 95 cents (5 francs). If this be true, the getaa receives about twice as much for harvesting Fteemy as for harvesting Deglet Noor dates, which seems improbable.

It is said that the fruits of some varieties can be preserved only by leaving them on the bunch until they are completely dry, when they can be detached. Others which are especially liable to become wormy should be dried in the sun, after first splitting them open and removing the seeds.

VARIETIES OF THE DATE PALM IN TUNIS.

While it is impossible to state exactly the number of well-defined varieties of the date palm occurring in Tunis, it is probably not far from 150. The Jerid oases are particularly rich in varieties, containing considerably more than 100 distinct kinds.[a] Some of these are extremely local. At Nefta several varieties were seen that apparently do not occur at Tozer, while in the Nefzaoua there are many kinds that are very rare or entirely wanting in the Jerid, and vice versa. Yet certain varieties (the Kenta and Areshty, for example) are widely distributed, being found not only in all the Tunis oases, but also in those of eastern Algeria. Each group of oases in Tunis has its characteristic varieties. Thus, in the Jerid the Fteemy is by far the most abundant sort, while in the Nefzaoua, Gabes, and Gafsa groups it is rare or absent. Varieties such as Doonga and Zekry, which are important and highly esteemed in the Nefzaoua, are hardly known in the Jerid, although the nearest oases of the two groups are only about 30 miles distant. The Boo Hath'm variety, one of the most abundant at Gabes and at Gafsa, is apparently wanting in the two other groups.

Nearly all the gardens contain a large number of varieties, mixed together in the greatest confusion. Only in the newer gardens of the Jerid do we find plantations of the Deglet Noor occupying areas of some size, to the exclusion of other kinds. One large garden at Tozer is remarkable for containing almost solely the Deglet Noor and Fteemy varieties, but this is a rare exception. The present tendency is to plant Deglet Noor offshoots as fast as they can be obtained, and very young plantations on the edges of the oases of Tozer and Nefta (Pl. VII, fig. 2) often contain only Deglet Noor and Fteemy palms.

---

[a] Du Paty de Clam published (Bul. de Géogr. Hist. et Descr., No. 3, 1893) a list of 74 varieties found in the Jerid. Masselot (Bul. Dir. Agr. et Com. Tunis, pp. 146–161, 1901) enumerates 94 named varieties. The writer was able to obtain fruit of all but 23 of these, and examined fruits of 21 named varieties not included in Masselot's catalogue.

In this bulletin only varieties that exist in the Jerid and Nefzaoua oases are treated. However, most of the important Tunisian varieties are thus included, there being few at Gafsa and at Gabes which do not also occur in one or both of the other groups. Descriptions are given of all the varieties that are at all abundant in the Jerid and the Nefzaoua, as well as of all that could be found that are noteworthy for their quality. Yet there are probably three times as many named and well-defined varieties in the region as are described in this paper; and the writer examined, photographed, and obtained samples of the fruits of nearly twice as many. Many of these, however, are extremely rare, in some cases being probably confined to a single garden.

Suckers of all the varieties described, with the exception of the Chedakh, Deglet Hamidatoo, Deglet Hassen, Khalt Menakhry, and Selatny, were brought to the United States.[a] Eleven varieties, of which suckers were imported, could not be included in the "Key to the varieties," at the end of this bulletin, as either the fruits were not seen or else samples and photographs were not obtained. Their characters, so far as known, are described under the heading "Varieties imported but not included in the key," page 90.

The Arabic names of the varieties alone are in use. In all matters of nomenclature and orthography Mr. W. T. Swingle, who has given much consideration to this subject, was freely consulted. In the main the names as given by the writer are identical with those given by Masselot,[b] although the spelling has been altered to the extent necessary to render it phonetic for English-speaking readers. The names of the varieties described in this paper which do not occur in Masselot's list are spelled phonetically as pronounced for the writer by the natives. In some cases, where the name of a variety differs in different oasis groups, the pronunciation current in the Jerid oases is followed as the standard.

At the end of this report, in the descriptive key (p. 97), the fruit characters that appear to be most useful for the identification of the varieties are described in detail. In the present chapter, brief descriptions of the fruits as to size, shape, flavor, and keeping quality, and in many cases of the characters of the palms themselves, are given. Geographical distribution, abundance or rarity, productiveness, earliness of ripening, commercial importance, vigor, rapidity of growth, and alkali resistance are also discussed.

---

[a] These five varieties are nevertheless described, the first because of its abundance, and the others because of their fine quality; and thus practically all the important varieties of the Jerid are treated in this paper.

[b] Bul. Dir. Agr. et Com. Tunis, pp. 146–161 (1901).

In classing the varieties as of first, second, or minor importance, such points as the size, flavor, earliness of ripening, and keeping quality of the fruit, the thickness of the flesh, and the proportionate size of the seed, as well as the rapidity of growth, hardiness, and productiveness of the trees have all been considered. Thus the Fteemy variety (Pl. X, fig. 3), although not ranking with the Deglet Noor (Pl. VIII, fig. 1) in respect to flavor and cleanness of skin, is yet a very attractive date and is remarkable for the ease with which it is propagated, its rapid growth, vigor, and productivity. Hence it has seemed advisable to place it in the first class, and the Kenta variety (Pl. X, fig. 2) has been inserted there for similar reasons. On the other hand, the Mokh Begry (Pl. X, fig. 4), although of delicious flavor and highly esteemed by the Arabs, is not as attractive as other kinds in the shape and size of its fruit, besides being a rather light bearer. Consequently it is ranked as of secondary importance.

It should be remembered that, in judging such characters as flavor, personal bias enters very largely into the equation. In regard to the fruits of several varieties, the writer's opinion did not at all agree with that of the inhabitants of the oases, nor has it always coincided with that of colleagues in the Department of Agriculture with whom he has compared notes in testing dates.

Another point that should be emphasized is the great likelihood that the varieties imported will undergo more or less change in their new environment, some improving and others deteriorating. It is by no means impossible that varieties which in Tunis appear to be second-rate or even of minor importance will take rank among the best when grown in the United States, and that some of the kinds that are classed in this paper as of first importance will not prove to be the best adapted to our conditions. At all events it will be extremely interesting to watch the behavior of the Tunisian varieties that have been introduced into the United States.

Among Tunis dates the Menakher variety (see also p. 60) must be given first rank, so far as the quality of the fruits is concerned. (See Pls. V and VIII, fig. 2.) These are fully equal to the Deglet Noor in flavor, cleanness of skin, and keeping quality, and are usually $1\frac{1}{2}$ to $1\frac{2}{3}$ times as large as the latter. The fruits appear to ripen earlier, and the trees are said to give considerably heavier yields than the Deglet Noor variety. Unfortunately Menakher palms are so extremely rare that only nine offshoots of this variety could be obtained for importation into the United States. Even rarer is the Selatny date (see fig. 52, p. 93), the fruits of which resemble and perhaps equal the Deglet Noor in flavor, and are as large as those of the Menakher. These two varieties are in fact nearly extinct. At the ordinary rate of propagation it would require a great many years to obtain offshoots in sufficient numbers for commercial plantations. Yet the excellent quality and the large size of these dates would undoubtedly make them marketable at high prices if they could be had. So far as Selatny is concerned, there seems to be little chance of obtaining offshoots, but the Menakher variety has been introduced in sufficient number to give a fair opportunity for establishing it in this country. It remains to devise some means of speedy propagation by means of smaller offshoots than are generally taken for planting. Perhaps the offshoots can be removed before they have formed roots and then can be nursed in greenhouses until well rooted. The variety is so promising that no pains should be spared in multiplying it as rapidly as possible.

As regards actual commercial importance, the Deglet Noor variety is easily first. (Pls. VI, fig. 1, and VIII, fig. 1.) No other kind that is at all common equals it in quality. Its exquisite flavor, handsome appearance, cleanness of skin, and admirable keeping quality give it a deserved preeminence among the dates that are extensively grown in North Africa, and have made it the only Algerian or Tunisian date that is largely exported to Europe and America. Yet it has some serious disadvantages, else it would be hardly worth while to experiment in this country with any other variety. The greatest of these is its late ripening, or, in other words, its very high requirement as to total heat, a requirement that can probably be met in but very few localities in the United States. Another drawback is the relatively small average yield of the palms. In both these regards the Menakher variety appears to surpass the Deglet Noor, while equaling the latter in the quality and greatly exceeding it in the size of the fruits.

The Boo Affar (Pl. IX, fig. 2) is hardly inferior to the Menakher in many of the qualities of a first-class date. Its large fruits have a very fine flavor and very thick flesh, abounding in sugar. It is one of the handsomest of dates, being especially noticeable for its splendid coloring. The large size and unusual, almost perfectly globular shape of the Tronja date (Pls. IV, fig. 1, and IX, fig. 1) will at once attract attention. These peculiarities are associated with great thickness of flesh and a very rich flavor. Unfortunately, not much is known as to the productiveness of the variety. The Boo Fagoos (fig. 10, p. 67) is also remarkable for the form of its fruit, which is somewhat fiddle-shaped and of fairly large size. It has a very rich, attractive flavor, and, like the Tronja, is held in high esteem by the natives of the region where it grows. All three of these varieties offer great possibilities as a fancy dessert fruit, commanding a high price in the market.

The Tafazween (fig. 11, p. 68) is the best of the rather long, slender dates examined by the writer. It is decidedly attractive, with its bright bay color and transparent flesh, nor does its flavor belie its appearance. It seems to be an earlier ripening kind than the Deglet Noor, and might be expected to take its place in regions where the sum total of temperatures is not quite sufficient to ripen the latter.

Although decidedly inferior in flavor and probably in keeping quality to the Deglet Noor, the Fteemy (Pls. VII and X, fig. 3) is a fine variety. It is by far the most abundant kind grown in the Jerid oases and is surpassed by none in productiveness, rapidity of growth, vigor, and hardiness. The fruit is handsome and highly colored, the flesh soft and sirupy, and the flavor so rich and sweet that Fteemy dates can not be eaten in large quantity at any one time. In the writer's judgment this is a finer fruit than the Rhars, that is so extensively grown in Algeria, although it shares with the latter the disadvantage of being sticky when fresh and consequently difficult to handle as a dessert fruit. It is a late-ripening sort, little if at all earlier than the Deglet Noor, and hence should not be planted except in the warmest localities of the Southwestern States. It has, however, a decided advantage over the Deglet Noor variety in point of rapidity and vigor of growth and in productiveness, being said to yield heavily every year.

Areshty (fig. 13, p. 71) is a variety considerably resembling the Boo Affar in size and shape, but is less richly flavored and less brightly colored. In its rather firm flesh and wholesome, moderately sweet flavor it resembles dates of the dry class. Were it not for the great size of its fruits it would be somewhat doubtful whether this should be classed as a variety of primary importance, as the flavor, although attractive, is not to be compared with that of the Deglet Noor and hardly equals that of the Fteemy variety.

The Horra variety (Pl. X, fig. 1) is very highly spoken of by French settlers in the oases, and is exported in small quantity to Europe. While from a botanical point of view it belongs to the "dry date" class, in reality its flesh is thick and never becomes very dry or hard. It is easily the finest of its type. The flavor is delicious, yet not so rich as to fatigue the palate. When we consider, furthermore, the good size of the handsome fruit, its early ripening, and the hardiness of the palms, there seems ample justification for giving the Horra a very high rank among Tunisian varieties.

Ranking next after the Horra among the dates of the dry type is the Kenta variety (Pl. X, fig. 2). This has a medium-sized fruit, smaller than the Horra. Its flesh is thicker and more tender than in most of its class. It ripens early, preserves well, and is one of the most productive of all varieties. The flavor is very agreeable and wholesome, while not so rich as to be easily cloying. Kenta palms appear to be unusually hardy and resistant to alkali in the soil.

DESCRIPTIONS OF THE VARIETIES.

In the descriptions that follow, the page number placed after the name of each variety refers to the descriptive key at the end of the bulletin (pp. 97–106), where a more detailed account of the characters of the fruits will be found. It should be noted that with few exceptions all the varieties can readily be referred to one or the other of two principal types—the "dry dates" and the "soft dates." (See p. 96.) The first are characterized by having the skin of the ripe fruit mostly roughened with numerous hard, narrow, transverse, as well as longitudinal, wrinkles, while the flesh is usually thin and generally becomes quite hard and dry in fruit that is long preserved. Plate X, figure 1, illustrates a typical date of this class. The soft dates, on the other hand, have the skin of the ripe fruit loosened over a great part of the surface into a few large, soft blisters, and the flesh is usually thick and remains soft, or at least tender. Typical soft dates are illustrated in Plates VIII and IX, figure 2. Dates of the first type are only moderately sweet, and as they can be eaten in quantity without inconvenience they form a large part of the food of the Arabs. Some of them, like Horra and Kenta, have a delicious flavor, while others are insipid. The soft dates, on the other hand, are generally so rich and sweet as to be rather a dessert fruit than a staple article of food. To this category belong the highly prized Deglet Noor, the choice Menakher, the rich, sirupy Fteemy—in short, most of the finest varieties. While many of these can be kept for a long time in good condition, others are not preservable, but must be eaten fresh or, at most, a few weeks after they are gathered.

Under the first heading following—"Varieties of primary importance"—these are arranged as nearly as possible in the order of their value, as determined by the considerations mentioned above. Under the headings "Varieties of secondary importance" and "Varieties of minor importance" the varieties follow the order in which they are placed in the key. The "Varieties imported but not included in the key" and "Varieties included in the key but not imported" are arranged alphabetically.

VARIETIES OF PRIMARY IMPORTANCE.

SOFT DATES.

MENAKHER (p. 106).—Fruit of the soft-date type (Pl. VIII, fig. 2), 2 to 2¼ inches long, about one-half as wide, oblong, broad and rounded at both ends, keeping its shape well when preserved; brownish maroon when ripe; the flesh 2 to 2¼ lines thick; the seed broad at both ends, about one-half as long as the fruit, one-half as wide as long, very rough. (Fig. 6.)

The leaves (Pl. V) are long and broad and rather stiff and heavy, crowded with very numerous long leaflets, and their stalks are armed almost throughout their length with long, stout spines. The fruit clusters are short and dense, their stalks bright yellow (not at all orange), rather short, stout, and only moderately curved, so that the bundles do not hang down below the leaves, as in the Deglet Noor, but are almost hidden by the foliage..

This superb variety produces fruit that is thought by many of the natives, and even by some of the few Europeans who have tasted it, to surpass the Deglet Noor. In the writer's judgment and that of several of his colleagues who have given much attention to the subject of dates, as well as in the opinion of the experts attached to two of the largest American firms that import fruits, it is at least equal in quality to the Deglet Noor, which it considerably resembles in flavor. In size Menakher dates are one and one-half to nearly two times as large as the Deglet Noor.[a] In color they are generally darker. The seed, though thick, is short in proportion to the length of the fruit, and it is very different in appearance from that of the Deglet Noor. The thick, translucent flesh, although soft and sirupy at the moment of ripening, becomes firm when preserved, just as does that of the Deglet Noor. At the same time, it does not become dry and hard after a few months, as in most of the dry dates. If preserved with any care, Menakher dates keep their shape admirably. Those that were examined and tasted by the writer after having been kept for three or four months in the houses of natives showed themselves to be in all respects equal to the Deglet Noor in keeping quality. As in that variety, the

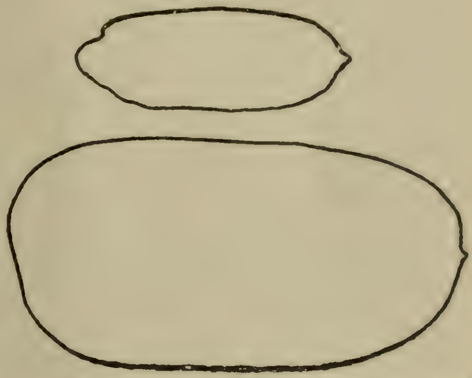


Fig. 6.—Outlines of Menakher seed and fruit. (Natural size.)

---

[a] Samples of Menakher and of Deglet Noor dates have recently (December 5, 1905) been received by the writer, through the kindness of Mr. Louis Grech, of Nefta, in southern Tunis. A comparison of the two shows that in volume (determined by the displacement of water) the former average 15 c. c. and the latter 9 c. c., the Menakher dates being, therefore, one and two-thirds times as large as those of the Deglet Noor variety. They are also about one and two-thirds times as heavy, Menakher fruits averaging 16.76 grams in weight, while Deglet Noor fruits average 10.44 grams. The percentage weight of the seed to that of the whole fruit (i. e., with the seed) is 10.4 in the case of the Menakher and 9.8 in the case of Deglet Noor. The importance of this character in distinguishing date varieties was first pointed out by Prof. J. W. Toumey. An exceptionally large Menakher fruit weighed 18.7 grams and the seed 1.7 grams, or only 9.1 per cent of the weight of the whole fruit.

skin does not become sticky, but remains dry and clean, which is a very desirable property in a dessert fruit.

An objectionable feature in Menakher dates is the strong development of the white, stringy core, or "rag," to borrow a term from the orange growers. This diminishes perceptibly, however, in thoroughly ripe fruit. The consensus of opinion among those who examined the two samples from Nefta mentioned in the footnote on page 61 is that in point of appearance, cleanness of skin, keeping quality, and delicacy of flavor the Menakher dates surpassed the Deglet Noor, while the latter are superior in the crisper texture of the flesh and the smaller development of stringy core. Menakher dates are generally reserved for the tables of the wealthier natives and for gifts to their friends. On the rare occasions when they are sold they are said to bring about one-third more than Deglet Noors.

The Menakher variety ripens its fruits in the latter part of October. It is said to yield little during the first few years after the offshoots are planted, but afterwards surpasses the Deglet Noor in yield, one palm producing sometimes 220 pounds of dates. Single clusters are said to be sometimes too heavy for a strong man to carry.

Menakher palms occur in the oases of Nefta, Tozer, and El Oudiane of the Jerid group, and are said also to occur in the Nefzaoua region, although the writer could not confirm the latter statement. They are everywhere, however, extremely rare, being found usually only in the largest and finest gardens, with rarely more than one individual in each garden. In the oasis of El Oudiane, where palms of this variety are said to be most frequent and to produce the finest fruit, there are probably not more than 12 or 15 trees, and most of these are old ones, no longer producing offshoots.

The natives give a curious account of the great rarity of this variety, which they hold in high esteem, and almost veneration. It appears that in former times the bey and other great dignitaries of the country were excessively fond of Menakher dates, and were in the habit of sending their agents to the Jerid at the time they ripen in order to procure them. As their fondness for these dates increased they began to appropriate the entire crop, leaving none for the unfortunate owners of the trees, and often forgetting to pay for what they took. Consequently the proprietors, in disgust, stopped planting offshoots of this variety and sometimes even went to the length of cutting down old palms.[a] Nowadays so few offshoots are left that there is some danger of the complete extinction of the variety. Even if every effort were made to reestablish it, it would require many years before Menakher dates could be produced in large quantity.

---

[a] The natives give the same explanation of the extreme rarity of the prized Selatny (see p. 93), the only Tunisian variety which might be considered first class of which the writer failed to procure offshoots.

Although the Arabs invariably relate the history given above in attempting to account for the passing of this choice variety, it is possible that there are other reasons for its rarity. Some of the gardeners who are familiar with it say that very careful nursing is required to make Menakher offshoots live and grow. On the other hand, Si Brahim Ben Ouedi, of Nefta, the owner of a fine young palm of this variety, says that while great care must be taken in detaching and planting Menakher offshoots, they are afterwards as easy to grow as those of other varieties.

After an exhaustive search of all the Jerid oases for Menakher offshoots only nine could be obtained for importation into the United States, of which six were so small that little hope was entertained of their living. Fortunately, they have been given every care in the cooperative date gardens of the Department of Agriculture and the Arizona and California experiment stations at Tempe, Ariz., and Mecca, Cal., and when seen by the writer in September, 1905, all of them seemed likely to grow. So even if this valuable date becomes extinct in the country of its origin, there is a fair prospect of its being continued in the United States. It should be stated that one of the finest of the offshoots was a gift to the Department of Agriculture on the part of Si Brahim Ben Ouedi, of Nefta, from the tree mentioned above and represented in Plate V, figure 1.

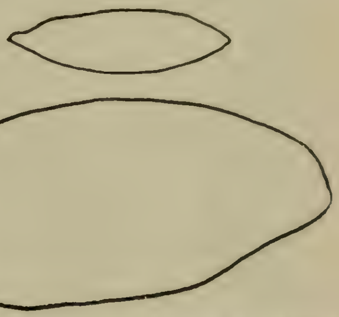


FIG. 7.—Outlines of Deglet Noor seed and fruit. (Natural size.)

DEGLET NOOR (p. 104).[a]—A soft date (Pls. I and VIII, fig. 1) 1⅓ to a little over 2 inches long, and about one-half as wide, ovate oblong in shape, generally widest at or near the middle, and blunt pointed at the apex, often narrowed also at the base, maroon colored when ripe, the flesh 2 to 3 lines thick, translucent, the seed a little more than one-half as long as the fruit, conspicuously pointed, and dark chestnut-brown in color. (Fig. 7.) The stalks and branches of the fruit clusters are bright yellow (not orange), the stalks long and slender, sharply curved near the base, so that the bunches hang down far below the crown of foliage. (Pl. VI, fig. 1.) The trunk is comparatively slender. The foliage is light and delicate looking, and the narrow leaves and leaflets are rather yellowish green. The spines are slender and weak.

This well-known variety is largely exported to Europe from Algeria and Tunis, and is practically the only North African date that is known in the United States. There can be no doubt that the

---

[a] Described in Bul. 53, Bureau of Plant Industry, pp. 33–36.

Deglet Noor presents a combination of characters—fine flavor, sweetness, attractive appearance, cleanliness, good keeping quality—that can be rivaled by no other variety that is widely grown in Algeria and Tunis. Only among very rare sorts, such as the Menakher (see p. 60), is there any possibility of its meeting a competitor. Even in the oases themselves it is the only kind that is found on the tables of Europeans or that is served by the more wealthy natives to their European guests. The general recognition of the superior quality and the commercial importance of the Deglet Noor is shown by the fact that the "kanoon" tax levied by the Tunisian government upon date palms in full bearing amounts to 1⅓ francs (25½ cents) for each Deglet Noor tree, and only two-thirds of a franc per tree for all other varieties.

The Deglet Noor ripens its fruit to perfection in the oases of the Jerid, and the government is attempting to establish it in the Nefzaoua region. Elsewhere in Tunis the climatic conditions are unfavorable to this variety, which is one of the latest sorts to ripen and requires a high sum total of mean temperatures above 64.4° F.[a] to bring it to perfect maturity. The maritime climate of Gabes is particularly ill adapted to the Deglet Noor, and the trials that have been made of it there have been unsuccessful.

First introduced into Tunis from the Oued Rirh, in Algeria, some 200 or 250 years ago, there are said to be now some 50,000 trees of this variety in the Jerid oases, in which case it constitutes 7 to 8 per cent of the total number of palms of all varieties.[b] The development of a very respectable export trade in Deglet Noor dates during the past ten or fifteen years[c] has stimulated the natives to plant trees of this variety, and the proportion of Deglet Noor to other palms will doubtless steadily increase from this time forward. As sufficient offshoots of this variety are not produced in their own gardens, the inhabitants of the Jerid have secured a modification of the Tunisian law against the importation of living plants,[d] thus allowing them to bring offshoots from the Oued Rirh oases in Algeria.

---

[a] Estimated by W. T. Swingle (Bul. 53, Bureau of Plant Industry, p. 67) to aggregate 3,600° F.

[b] The total number of productive date palms in the Jerid in generally placed at from 600,000 to 700,000, although some authorities estimate as high as 1,000,000 trees.

[c] Estimated in 1893 to amount to 660,000 pounds, while in 1904 more than four times that quantity (2,860,000 pounds) is said to have been purchased for export—550,000 pounds by a single French firm. The annual exports of Deglet Noor dates from the ports of Tunis are said to have averaged in recent years 1,175,000 to 2,200,000 pounds, all of this quantity having been grown in the Jerid oases.

[d] Designed to prevent the introduction of phylloxera.

As to the quality of the Deglet Noor dates produced in the Jerid oases, the buyer for a well-known French importing house, who had operated during several previous years in the Oued Rirh but who last season (1904) made his purchases in the Tunis oases, was of the opinion that the latter region surpasses the Oued Rirh oases in the quality of its Deglet Noor dates. As compared with the fruits of this variety grown in the Oued Souf,[a] those of the Jerid are larger, softer, and of finer appearance, while the Deglets of the Souf are said to be superior in keeping quality.

The natives consider a sandy soil as decidedly more favorable to the quality of the Deglet Noor fruit than one containing much silt or clay.

Deglet Noor dates begin to ripen in quantity in the Jerid toward the end of October; Masselot gives October 25 as the usual date. The harvest of 1904 commenced about that date and continued throughout November, December, and the first days of January, 1905. The crop is generally purchased on the trees for about two-thirds of the price which the dates bring at wholesale at Marseille, and the buyer undertakes the gathering[b] and packing of the fruit. In 1904, when the crop was an unusually abundant one both in the Jerid and the Oued Rirh and the price correspondingly low, these dates sold on the trees for about $2.59 per 100 pounds, and brought at Marseille from $3.54 to $3.88. In 1903, when the crop was much smaller, Deglet Noor dates from the Jerid sold at Marseille for from $4.75 to $4.80 per 100 pounds. The season of 1904 was unusually favorable to the quality as well as the yield, less than 0.3 inch of rain having fallen at Tozer during the months of September and October together, and only 0.2 inch during November.

The Deglet Noor is slower in coming into full bearing than most other varieties, the palms generally not giving a good crop until they are ten years old, while the Fteemy variety begins to yield largely when only four or five years old. The fruit of very young trees is said to be usually inferior in quality. While some varieties bear well every year, a Deglet Noor palm produces largely only every second or third year, and the average crop is smaller than that of many less esteemed kinds. The average yield in the Jerid of Deglet Noor palms in full bearing is stated by one authority to be 132 pounds,[c] while for the Fteemy and Kenta varieties 200 and 300 pounds, respectively, are not considered extraordinary yields.

---

[a] See Bul. 86, Bureau of Plant Industry, p. 24.

[b] See p. 52 for an account of the methods of harvesting.

[c] In Algeria the average product of this variety is variously estimated to be from 88 to 132 pounds. (See Bul. 53, Bureau of Plant Industry, p. 35.) On account of its relatively low productiveness and its delicacy of constitution, the inhabitants of the Mzab oases are somewhat prejudiced against this variety, notwithstanding the undeniable excellence of its fruit. But, being largely

Opinions differ in the Jerid as to the degree of resistance of this variety to large amounts of salts in the soil. The proprietor of one garden at Tozer, in a part of the oasis where there is much saline efflorescence, regarded the Deglet Noor as the most susceptible of all varieties to the effect of "alkali," while at El Hamma experts in date culture told the writer that, if freely irrigated, this variety shows a high degree of resistance.

Boo Affar (p. 101).—A soft date (Pl. IX, fig. 2), about 2 inches long and from a little more than one-half to three-fifths as wide, conspicuously wider above than below the middle but narrowed to the blunt apex, bright purplish maroon when ripe, the flesh 3 to 3½ lines thick, tender yet firm, the seed a little more than one-half as long as the fruit, cinnamon brown. (Fig. 8.) The stalks and branches of the fruit clusters are deep orange. The foliage is said to be heavy and the leaves wide and very green.

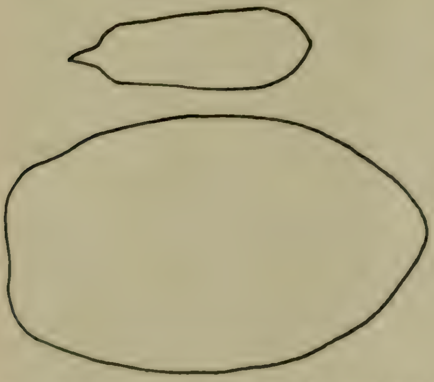


Fig. 8. Outlines of Boo Affar seed and fruit. (Natural size.)

This variety occurs in the gardens of El Hamma oasis (Jerid) and in the Nefzaoua, but is nowhere common. The fruit is remarkable not only for its large size, thick flesh, and delicious flavor, but for its beautiful coloring, its tints rivaling those of scarlet oak leaves in the autumn. The fruit ripens rather late (in November, according to Masselot). It resembles that of the Areshty variety (see p. 70), but is much more highly colored. It is said to be better flavored than the Areshty when thoroughly ripe, and in the writer's opinion this is true. On the other hand, the natives prefer the fruit of Areshty to those of Boo Affar when only partly ripe. The flesh is tender, yet rather firm, and is very sweet and full of sugar. The skin, even of the ripe fruit, is fairly clean and dry. Of this variety 8 offshoots were imported.

Tronja (p. 99).—(Also spelled Troundja.) A soft date (Pl. IX, fig. 1), perfectly round, or nearly so, 1½ to nearly 2 inches in greatest diameter, maroon to prune purple when ripe, the flesh 4 to 5 lines thick, very sugary, yet firm; the seed very thick, six-tenths to seven-tenths as long as the fruit and about three-fifths as long as wide.

---

engaged in other business, they are not so dependent for a livelihood upon the product of their date palms as are the natives of other Saharan oases, else they would probably attach greater importance to the commercial superiority of the Deglet Noor. (See Charlet, in Bul. Soc. Géogr. d'Alger, 1905.)

much furrowed. The foliage (Pl. IV, fig. 1) is dense, the leaves wide, crowded with leaflets, and drooping gracefully at the ends.

This is a rare variety, apparently confined to Tunis, occurring sparingly in the Jerid and the Nefzaoua. The fruit, which ripens in October, is remarkable for its large size, the thickness of its flesh, and its globular shape. The short, very thick seed is also characteristic. (Fig. 9.)

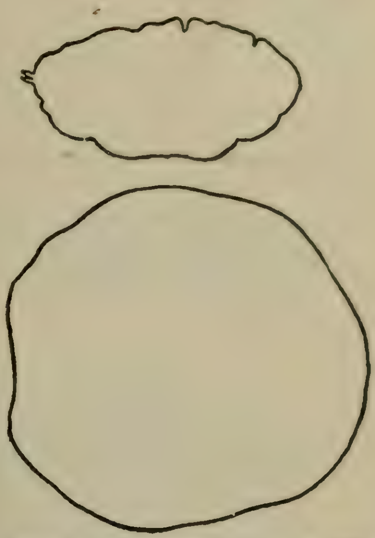


FIG. 9.—Outlines of Tronja seed and fruit. (Natural size.)

This date is highly esteemed by the natives. The flesh is very firm and even somewhat tough, extremely sweet, and very rich flavored, the flavor suggesting that of the Fteemy. Tronja dates can not be eaten in large quantity, as their richness soon cloys, but as a dessert fruit they are very promising. They ripen in October. Of this variety 8 offshoots were imported.

Boo Fagoos (p. 101).—The name (in French orthography, Bou Fagous, or Feggouss) signifies "father of the cucumber." A soft date, $1\frac{2}{3}$ to $1\frac{7}{8}$ inches long, considerably more than one-half as wide, constricted near the middle and widest toward the apex, maroon to prune purple when ripe, the flesh $2\frac{1}{2}$ lines thick, the seed from a little more than one-half to five-eighths as long as the fruit, rather slender. (Fig. 10.) The orange-colored stalks of the fruit clusters are sharply curved and so short that the rather small bunches hardly extend beyond the leafstalks. The foliage of this, as of several other of the finest varieties, is of a light and delicate aspect, due in this case to the relatively few leaves and the narrowness of the leaflets. The leaves themselves are large and wide. As in the Deglet Noor, they curve downward very noticeably. In color they are an unusually rich green. The spines of the leafstalks are few and weak. The offshoots remain small while attached to the parent tree, and the Arabs advise that greater care be taken to keep them moist after removal and before planting than is necessary with most other varieties.

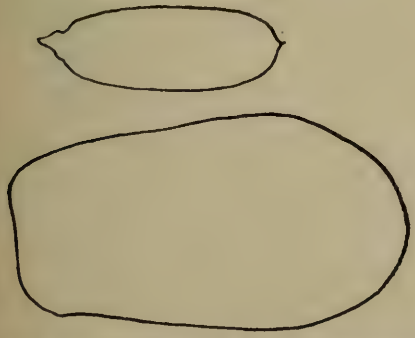


FIG. 10.—Outlines of Boo Fagoos seed and fruit. (Natural size.)

The variety is rather common, but nowhere abundant, in the oases of the Jerid, to which it appears to be confined in Tunis, although said to occur also in the Mzab oases of Algeria. It is in high repute among the natives, being exported to all parts of Tunis and Algeria. The large fruit is remarkable for its unusual shape, somewhat like that of some varieties of gherkins, to which it doubtless owes its Arabic name. The flesh is thick and rather firm, yet tender. It is very sweet and has a very distinctive and highly attractive flavor. It ripens late in October. Of Boo Fagoos offshoots 16 were imported.

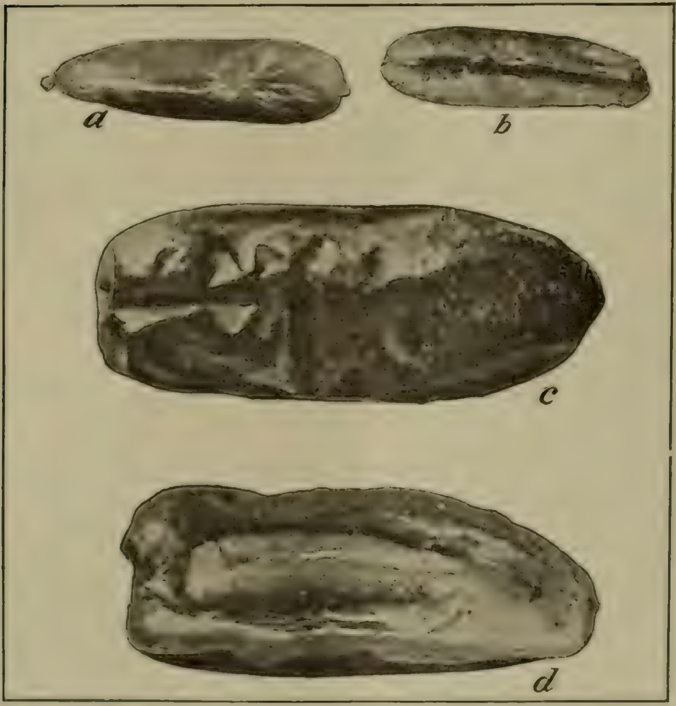


FIG. 11.—Tafazween seeds and fruits. (Natural size.)

Tafazween (p. 101).—(Name spelled by French writers "Tafazaouine.") A soft date, 2 to 2⅙ inches long, about two-fifths as wide, oblong, tapering slightly from base to apex, bright bay colored when ripe, the skin conspicuously marked with short linear scars, the flesh 1½ to 2 lines thick, the slender seed about three-fifths as long as the fruit. (Fig. 11.)

This variety is common in the Oued Souf, in Algeria, where it is considered one of the best dates of the region.[a] It is also found in the Mzab and Oued Rirh oases of Algeria. In the Jerid, where the name is pronounced "Tafazweent," it is extremely rare. The handsome fruit is easily recognized by its long, narrow shape, bright bay color, and curiously marked skin. It is said to ripen in October. The flesh is soft and translucent, like that of the Deglet Noor. It is very sweet and of excellent flavor, in this respect somewhat resembling Lagoo, but superior. Twenty-one offshoots of this promising variety were imported, of which only one was obtained in Tunis.

Freemy (p. 106).—(Name spelled by French authorities "Ftimi.") A soft date (Pl. X, fig. 3), 1⅔ to 2 inches long, about one-half as wide, oblong, slightly narrowed at both ends, dark purplish maroon when ripe, the surface shining, the flesh soft and sirupy, about 2 lines thick, the seed a little more than one-half as long as the fruit, slender. (Fig. 12.)

---

[a] See Bul. 86, Bureau of Plant Industry, p. 26.

The foliage of this variety (Pl. VII) is luxuriant and the numerous leaves are long, wide, and crowded with long, broad leaflets. In color they are decidedly bluish, owing to the presence of a heavy white bloom. When this is rubbed off, a rich, deep grass-green color appears. The spines are stout and green. The deep orange-colored stalks of the fruit clusters are shorter, much stouter, and much less bent than in the Deglet Noor, so that the bunches do not hang down below the crown of foliage, as in that variety. The clusters themselves are shorter and more crowded with fruit.

This is by far the most abundant variety in the Jerid oases, comprising probably at least one-third of all the date palms in that region. The best fruit of this variety is said to be produced in the oasis of Kriz (El Oudiane). In the Nefzaoua it is not abundant, and in the oases near the coast it is of relatively small importance. In the oases of eastern Algeria, although geographically so near the Jerid and in such close communication with the latter region, this variety seems to be little known, although at Ourlana, in the Oued Rirh, it is said to occur under the name of "Bou Aroussa" (father of the bride). After the Deglet Noor, Fteemy is the variety most generally esteemed among the natives of the Jerid. Its great importance is shown by the fact that it is apparently the only variety of which the fruits are differently designated, according to whether they are in the bunch (halig) or detached (mantoor). It is largely exported to other parts of Tunis and Algeria and even, it is said, to Europe (probably to Italy). It is one of the kinds that is most sought after by the nomadic Arabs who barter the grain they raise in the plateau region for the dates of the Jerid.

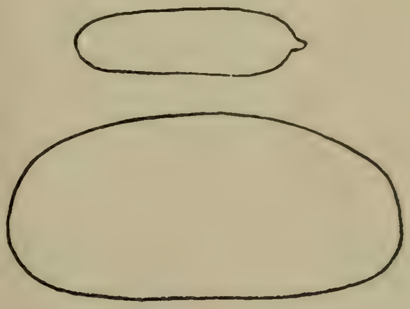


FIG. 12.—Outlines of Fteemy seed and fruit. (Natural size.)

Although inferior in flavor to the Deglet Noor, the Fteemy is unquestionably an excellent variety, greatly excelling the Deglet Noor in vigor, rapid growth,[a] early productiveness, and large yields. The oblong fruit when ripe is of a fine reddish-purple color, which contrasts strikingly with the deep orange branches of the clusters. It is very rich in flavor, extremely sweet, and so soft and sirupy as to melt in the mouth when fresh. It can not be eaten in great quantity, however, without cloying. A further disadvantage is that owing to the excess of sirup it contains, it becomes very sticky, and is therefore less satisfactory as a dessert fruit than the Deglet Noor. It is said to be easily preserved, and the Fteemy was enumerated at Kebili among the seven best-keeping sorts. Fteemy dates sold at Tozer in 1904 for about $1 per hundred pounds on the tree, which was about two-fifths of the price then being paid for Deglet Noor dates. The offshoots are cheaper than those of the Deglet Noor, 48 cents being the average price of a good offshoot.

---

[a] Mr. Bernard G. Johnson, who is stationed at the cooperative date garden of the Bureau of Plant Industry and the California experiment station at Mecca, Cal., reported in October, 1905, that among the offshoots from Tunis planted there in May of the same year, those of the Fteemy variety were showing signs of growth in larger proportion than those of any other kind.

The offshoots of this variety are frequently allowed to grow up around the parent stem, so that at length it is often hard to distinguish the original trunk. This is never permitted in the case of the Deglet Noor, the offshoots of that variety being always removed for planting while still quite small.

The habit of blossoming a second time, generally in July, is more characteristic of this than of any other Tunisian variety. The second-crop dates, being unpollinated, are seedless and remain small and green. In the autumn it is not uncommon to see large clusters of them overtopping the bunches of highly colored ripe dates. They remain upon the trees throughout the winter, and are said to become soft and edible in May.

The Fteemy variety is considered one of the most productive, giving a good crop every year. Trees bearing 15 to 20 well-filled clusters are frequently seen, and 200 pounds is by no means an unusual yield. The trees begin to bear a considerable amount of fruit when only five years old, so that this variety comes into bearing about twice as rapidly as the Deglet Noor.

Fteemy is a late-ripening variety, its fruit beginning to mature in quantity at the same time as the Deglet Noor (about October 20). As the dates can be left on the trees a long time after they are ripe without deterioration, unless much rain falls, the harvest of this variety is generally postponed until after that of the Deglet Noor. Fteemy dates are generally the last to be gathered, often remaining on the palms until the end of January.

In respect to ability to withstand "alkali" in the soil, the proprietor of a garden in the saline part of the oasis of Tozer told the writer that he considers this the most resistant variety, more so even than Kenteeshy. At Nefta the amins and other agricultural experts ranked it among the four most alkali-resistant varieties of the oasis. At El Hamma also it is regarded as one of the three or four most resistant kinds, provided it is abundantly irrigated. Of this variety 25 offshoots were imported.

ARESHTY (p. 101).—(Name spelled Arichti by French writers.) A soft date, 1⅔ to 2½ inches long, one-half to two-thirds as wide, slightly larger above than below the middle, broad and rounded at the apex, light bay or hazel brown when ripe, the flesh 2½ to 3 lines thick, firm but tender, the seed about one-half as long as the fruit, rather thick, irregularly roughened. (Fig. 13.) The stalks and branches of the fruit clusters are pale orange. The foliage of this variety is rather light, and the leaves droop somewhat as in Deglet Noor palms. The Arabs say that the foliage of the Areshty is greener than that of the Deglet Noor. The leaflets are long, narrow, and rather sparse. The spines on the leafstalks are comparatively few, slender, and weak. The trunk is stout.

Frequent in the oases of the Jerid, the Nefzaoua, and Gabes, but nowhere abundant in Tunis. At Gabes the fruits are smaller and duller colored than in the Jerid, and are said not to preserve well. It occurs also in Algeria, at Biskra, and in the Oued Rirh. This is one of the largest dates grown in Tunis. The fruit is generally egg-shaped. It ripens about the middle of October, but is considered by the natives to be at its best before it is perfectly mature, although to an American palate it would doubtless be preferable when ripe. The flavor of the thoroughly ripe fruit is agreeable, although not very remarkable. While not as rich and sweet as the Boo Affar (see p. 66), it is wholesome, nut-like, and not easily cloying. The flesh becomes quite firm and the ripe fruit keeps its shape well when preserved. Thirteen Areshty offshoots were imported.

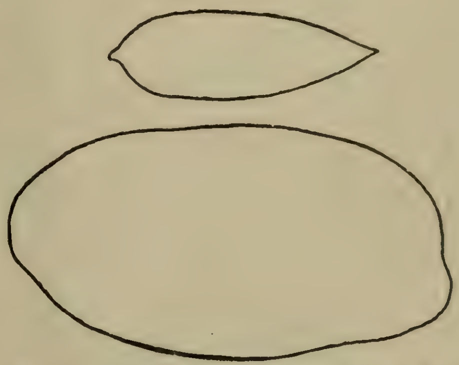


FIG. 13.—Outlines of Areshty seed and fruit. (Natural size.)

DRY DATES.

HORRA (p. 98).—The name is also spelled Hourra, Harra, and Herra, and means "pure" or "noble." A dry date (Pl. X, fig. 1), about 2 inches long, about one-half as wide, ovate, narrowed from the base to the rounded apex, rather dull purplish maroon when ripe, the flesh 2 to 2½ lines thick, with its white central zone much thicker than the dark outer portion, the seed usually about one-half as long as the fruit. (Fig. 14.) The stalks and branches of the fruit clusters are orange yellow. The leaves are large, with very numerous slender leaflets.

This variety, which also occurs in Algeria—at Biskra and in the Oued Rirh—is frequent in the Jerid and abundant in the Nefzaoua, where, the Deglet Noor not being grown, it is generally esteemed as the finest variety. At Gabes there are a few trees, but the variety does not thrive well so near the sea. The fruit is the largest and finest produced by any variety of the dry date class. This, indeed, can be regarded as a connecting link between the dry dates and some of the firm-fleshed type of soft dates (Khalt Horraowia, Khalt Mooashem, etc.). Horra dates ripen in September and October. The flesh becomes quite solid in the ripe fruit, but is never extremely hard and dry. It has the characteristic nutty flavor of the dry dates, but is much richer than most of them. It is at its best only when perfectly mature. Europeans who are acquainted with this date praise it highly. Du Paty de Clam[a] pronounces it a "rival of the Deglet [Noor]." The commandant of the French garrison at Kebili likes it better than the Deglet Noor, and gives it the preference over all other varieties for planting in his garden. Not only is it highly esteemed by the natives, but it is said to be exported to Europe and even to France. The caid of Kebili ranks it among the seven best-keeping varieties of the Nefzaoua. It is a medium early sort, ripening in the latter part of October. The palms have not a very vigorous look, yet they appear to be resistant to alkali in the soil and to thrive with less irrigation than such varieties as Deglet Noor and Fteemy. Forty-eight offshoots of this variety were imported. Nearly all of these were obtained in the Nefzaoua, as in the Jerid offshoots are scarce and the natives are reluctant to part with them.

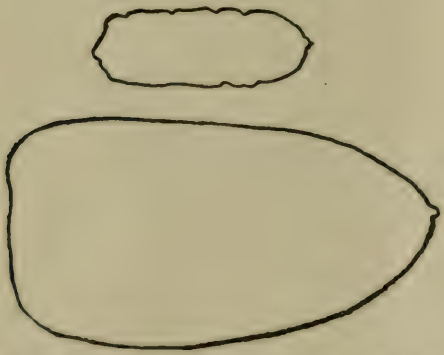


FIG. 14.—Outlines of Horra seed and fruit. (Natural size.)

KENTA (p. 97).—A date of the dry type (Pl. X, fig. 2), 1⅓ to 1⅔ inches long, about one-half as wide, narrowed from the middle or above it to the broad apex, dull bay colored when ripe, much of the skin loosened in large blisters in the ripe fruit, the flesh 1½ to 2 lines thick, the seed somewhat more than one-half as long as the fruit, rounded at both ends, light brown. (Fig. 15.) The leaves of this variety are rather broad, with numerous long, narrow leaflets. The long leafstalks are spiny only near the base. The light orange stalks of the fruit clusters are stout and horizontal or ascending, and so short that with the bunches they do not equal the leafstalks. The clusters themselves are short, thick, and densely crowded with fruit.

This is one of the most highly esteemed and most widely grown of the dry dates found in Tunis, and is said also to occur in Algeria. While abundant in the Jerid, it is relatively much more important in the Nefzaoua. One-fourth of the palms in the oasis of Kebili are said to be of this variety, and the French commandant there has selected it, together with Horra (see p. 71), for planting in his garden. It is also very important at Gabes, where it is ranked among the six best kinds of the region. The fruit is of medium size and, as indicated in the key (p. 97), is remarkable among the dry dates for the manner in which the skin becomes loosened into large blisters, which is usually a peculiarity of the soft dates rather than of the dry dates. The flesh is rather thin and becomes quite firm, although not very dry, in the perfectly ripe fruit. The surface is clean and dry, even when the fruit is quite ripe. It is not sirupy, although pleasantly sweet, and can be eaten in quantity without cloying. The flavor is very agreeable, wholesome, and of the nutty quality characteristic of most dry dates. Dates of this type, if extensively grown in this country, might become an important element in the diet of those who prefer vegetable to animal food.[a] Fruit of this variety is said to sell on the trees at $1.12 to $1.20 per hundred pounds, a little less than one-half the selling price of Deglet Noor dates.

---

[a] Etude sur le Djérid, Bul. Géogr. Hist. et Descr., No. 3 (1893). Separate, issued in 1894, p. 12.

The Kenta date is one of the best in keeping quality of the dry dates, retaining its shape perfectly and never becoming extremely hard, as do most of that class. At Gabes it is preserved in earthenware jars, and is said by the amins (agricultural experts) to be one of the two best keeping sorts of the region. One of the amins, wishing to emphasize its importance as a staple article of food, likened it to wheat or barley and the soft dates to confectionery. The caid of Kebili cited it among the seven best-keeping varieties. It is an important article of commerce between the inhabitants of the oases and the natives of other parts of Tunis and Algeria, and is said even to be exported from the Nefzaoua to Europe (probably to Italy).

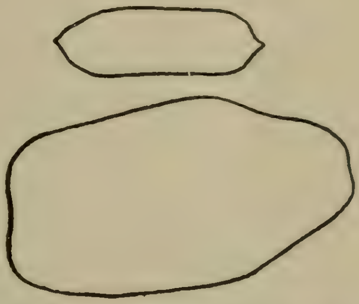


FIG. 15.—Outlines of Kenta seed and fruit. (Natural size.)

Kenta is a comparatively early ripening variety, maturing in the Jerid about the middle of October and perhaps earlier. Its fruits, like those of others of its type (e. g., Angoo and Remta), are said to be less liable than the soft dates to be spoiled if rain falls upon them when in the ripening stage. At Gabes it is regarded as one of the two most productive varieties. It is said to give an abundant crop every year. In the Jerid many trees are pointed out as yielding 330 pounds of fruit. M. Minangoin mentions a tree at El Oudiane that is said to produce 770 pounds, and also trees at Kebili at least 200 years old that still yield 265 pounds of fruit annually.

---

[a] As suggested by Mr. O. F. Cook. See Bul. 53, Bureau of Plant Industry, p. 31.

In the Jerid, Kenta is said to be the most salt-resistant variety in high-lying, well-drained land. At Gabes, on the other hand, it is cited as the only variety that is not salt resistant; but this may be because most of the saline land of the oases is low and badly drained.

Forty-three offshoots of this variety were imported, the great majority of which were obtained in the Nefzaoua oases.

VARIETIES OF SECONDARY IMPORTANCE.

DRY DATES.

Angoo (p. 97).—Fruit barely 1 inch long, about seven-tenths as wide, sometimes breadest below, sometimes above the middle, bright bay colored when ripe, much of the skin becoming loosened in large blisters, the flesh a little more than 1 line thick, becoming firm and dry, the white central portion thicker than the dark-colored outer zone, the seed about two-thirds as long as the fruit, about one-half as wide as long, light (drab) brown. (Fig. 16.) The stalks of the fruit clusters are lemon yellow (not orange). The branches of the clusters are very densely crowded with the small fruits, which hang on persistently after ripening instead of becoming easily detached.

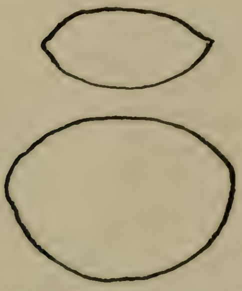


Fig. 16.—Outlines of Angoo seed and fruit. (Natural size.)

This, the smallest fruited of the Tunisian varieties, is found apparently only in the Jerid, and is best known as El Hamma. It appears to be nowhere common. Despite its diminutive size and thin flesh, this little date is one of the most attractive of the dry type. Because of its moderately sweet, nutty, wholesome flavor it can be eaten in large quantity without cloying, and should be a healthful food. Like Kenta (see p. 72), it is exceptional among the dry dates, because its skin becomes loosened into blisters over much of the surface of the fruit. The fruits are said to be little injured by autumn rains. They ripen in midautumn, keep well, and are much sought by the nomads of other parts of Tunis and Algeria. Of this variety ten offshoots were imported.

Thaby (p. 98).—The name, which means "golden," is also written "Dzhabi," and is sometimes pronounced as if spelled Derby.[a] Fruit 1⅔ inches or slightly longer, about one-half as wide, oblong, often slightly constricted a little above the base, somewhat pointed at apex, bright reddish brown when ripe; the flesh 1 to 1½ lines thick, rather tough, the dark-colored outer zone apparently much thicker than the white inner portion; seed about three-fifths as long as the fruit, rather slender. (Fig. 17.) The stalks and branches of the fruit clusters are rich orange colored.

---

[a] A variety called El Darbia, described as having a "green, dry fruit of medium size," occurs in Algeria.

This variety appears to be confined to the Jerid, and to be by no means common there. It is one of the handsomest of the dry dates, and one of the most attractive when preserved, keeping perfectly its shape and its beautiful warm, reddish brown color. Unlike most of the dry dates, in this variety the comparatively soft and dark part of the flesh is thicker than the firm, white core. It has an agreeable, wholesome flavor, and can be eaten in quantity without cloying It matures in October. Of the Thaby variety, fifteen offshoots were imported.

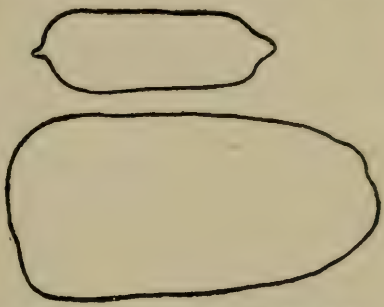


Fig. 17.—Outlines of Thaby seed and fruit. (Natural size.)

Lemsy (p. 99). Fruit 1½ to 1⅔ inches long, about one-half as wide, elliptical in outline, not conspicuously narrowed to the apex, often slightly curved, dull purplish maroon when ripe; the flesh 1 to 2 lines thick, becoming very firm and dry; the seed about two-thirds as long as the fruit, generally one-third as wide as long. (Fig. 18.) The branches of the fruit clusters are orange colored.

This variety is said to be known in the Nefzaoua as Halooa Hamra. It is common at Gabes and in the Nefzaoua, but is apparently wanting in the Jerid. It is a small, thin-fleshed, dry date, sometimes preserved, but usually eaten fresh and even before it is perfectly ripe, as the flesh soon becomes dry and hard. It is deliciously sweet and has a fine flavor, tasting somewhat like a chestnut. At Gabes, where it is regarded as a great delicacy, it is said to mature at the end of August, at the same time as Ammary (see p. 87). Of Lemsy two offshoots were imported.

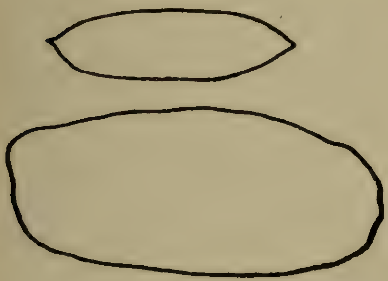


Fig. 18.—Outlines of Lemsy seed and fruit. (Natural size.)

Halooa Bayda (p. 99).—Also spelled "Halouaia," which designates the palm, "Halooa" referring to the fruit itself. The name means "white sweetmeat." Fruit 1⅓ to 1½ inches long, about one-half wide, elliptical in outline, not conspicuously narrowed at the apex, widest near the middle, dull purplish bay when ripe; the flesh 1 to 1½ lines thick, becoming very firm and dry; the seed about seven-tenths as long as the fruit and one-third to two-fifths as wide as long. (Fig. 19.) The branches of the fruit clusters are pale orange.

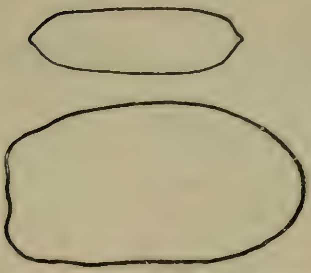


FIG. 19.—Outlines of Halooa Bayda seed and fruit. (Natural size.)

This variety, which is not common in the Jerid, abounds in the Nefzaoua. The Halooa of the Algerian oases appears to be distinct (see p. 99). It is much like the Lemsy (see p. 75), but the fruit is even smaller. It ripens rather early (October 10, according to Masselot), and is generally eaten fresh, becoming hard and dry when preserved. Because of their simple, wholesome flavor and not excessive sweetness, the writer found it possible to eat dates such as Lemsy and Halooa Bayda much more freely than the rich, sirupy kinds. Offshoots of this variety to the number of 24, mostly obtained in the Nefzaoua, were imported.

SOFT DATES.

MOKH BEGRY (p. 100).—French orthography, Moukh Begri. The name signifies "the brain of an ox." Fruit (Pl. X, fig. 4) 1⅓ to 1½ inches long, about three-fourths as wide, broadest at the base and narrowed thence to the broad rounded apex, flattened on the sides, bright bay colored when ripe; the flesh very soft, about 1½ lines thick, rather dark colored, translucent; the seed light brown, one-half to two-thirds as long as the fruit, about twice as long as wide, rounded at both ends. (Fig. 20.) The stalks and branches of the fruit clusters are light orange.

This is an extremely rare and much esteemed variety, apparently occuring only in the Jerid oases. The trees are said not to bear heavily. The dates are rather small and have an unusual shape. The translucent flesh is very soft, but the fruit is said to preserve well. It is very sweet and of delicious flavor, resembling and perhaps equaling the Deglet Noor. The fruits ripen in the latter part of October. After a thorough search only two offshoots could be procured for importation.

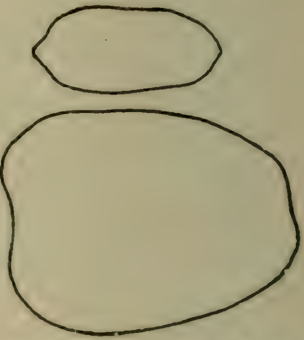


FIG. 20.—Outlines of Mokh Begry seed and fruit. (Natural size.)

BAYDH HAMMAM (p. 100).—The name means "pigeon egg." Fruit 1⅔ to 1¾ inches long, three-eights to five-eighths as wide, egg-shaped, broadest near the middle, rather conspicuously blunt pointed at apex, not keeping its shape well, dark chestnut brown with a tinge of maroon when ripe; the flesh very soft and dark colored, about 2 lines thick; the seed one-half to five-eighths as long as the fruit, one-third to two-fifths as wide as long, dark brown. (Fig. 21.) The stalks and branches of the fruit clusters are orange colored. The foliage is of a rather delicate aspect and the leaves numerous, the leaflets long, narrow, and rather sparse.

This is a handsome dark-brown date, with very soft dark-colored flesh. It is always eaten fresh, not being conservable. It is exceedingly sweet. The flavor of the perfectly ripe fruit is agreeable and very characteristic, resembling that of Tozer Zaid Safra (see p. 85). To the writer's taste, however, it is far less attractive than that of the Deglet Noor type or even of the dry dates, and it very soon cloys. The natives esteem it highly, as is shown by the fact that in harvesting the Baydh Hammam the clusters are carefully passed from hand to hand down the trunk, instead of being dropped to the ground by the man who cuts them. The Baydh Hammam is common in the Jerid, and is said to occur also in the Nefzaoua, as well as in Algeria (Biskra and Oued Rirh). It ripens rather late, hardly before November. Of this variety 20 offshoots were imported, all from the Jerid.

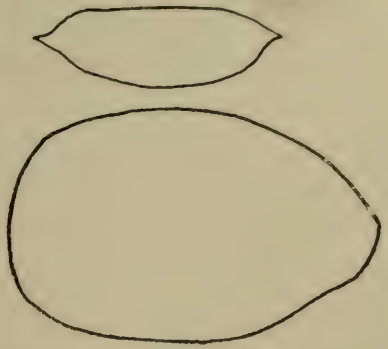


FIG. 21.—Outlines of Baydh Hammam seed and fruit. (Natural size.)

KSEBA (p. 100).—(Kessebi is probably another spelling of the same name.) Fruit about 1½ inches long, two-thirds as wide, ovate or oblong ovate, widest below the middle, purplish maroon or bay when ripe; the flesh 2 to 2½ lines thick, firm yet tender; the seed very nearly two-thirds as long as the fruit, two-fifths as wide as long, russet brown. (Fig. 22.) The branches of the fruit clusters are deep orange. The foliage is characterized by having few spines, and these are slender and weak.

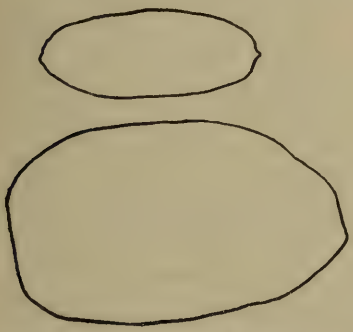


FIG. 22.—Outlines of Kseba seed and fruit. (Natural size.)

This variety is rare in the Jerid, but in the Nefzaoua, at Gabes, and at Gafsa it is one of the most important sorts. A date of the same name, described as a soft date, and possibly identical, occurs in the Oued Rirh oases of Algeria. The fruit, which preserves well, is very sweet and well flavored, in the latter respect being intermediate between Horra and Lagoo (see pp. 71 and 80). The Kseba variety, which ripens easily at Gafsa (see p. 20), may be found valuable for regions where the temperatures are not sufficiently high to mature the Deglet Noor and other choice sorts. Its fruits ripen in October. Offshoots to the number of 15 were imported.

DOONGA (p. 101).—Sometimes spelled "Denanga."[a] Fruit a little more than 1½ inches long, six-tenths to seven-tenths as wide, egg-shaped, broadest near the base, dull dark purplish maroon when ripe; the flesh 1½ to 2 lines thick, the firm white central portion nearly as thick as the soft, dark outer zone; seed small and thick, only about one-half as long as the fruit and about one-half as wide as long, narrowed at both ends. (Fig. 23.) The stalks and branches of the fruit clusters are light orange.

---

[a] The "Dengui" variety found at Gabes is a different date.

This variety, which is one of the most highly esteemed and frequently planted in the Nefzaoua, does not appear to be found in the Jerid. It is a dark-colored, rather small date, with moderately soft, dark-colored flesh, and with a clean, dry skin. It is very sweet and of a fine flavor, suggesting that of the Deglet Noor. The number of Doonga offshoots imported was 10, all from the Nefzaoua.

BESSER HALOO (p. 101).—Also spelled "Bisra Haloua." The name means a sweetmeat (haloo) that is eaten just before it is thoroughly ripe (besser). Fruit 1⅓ to 1½ inches long, about two-thirds as wide, broadest at or above the middle, rounded at the apex, keeping its shape well when ripe, bright bay colored; the flesh 2 lines thick, comparatively dry when the fruit is ripe, light brown; the seed two-thirds to three-fourths as long as the fruit, generally two-fifths as wide as long, with more or less conspicuous wing-like ridges on the sides. (Fig. 24.) The leaves are short and rather stiff, with comparatively short stalks and wide leaflets. The spreading or ascending stalks of the fruit clusters are so short that the small bunches are nearly hidden by the foliage.

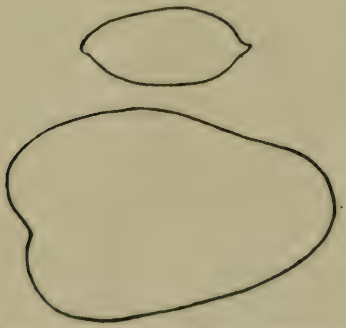


FIG. 23.—Outlines of Doonga seed and fruit. (Natural size.)

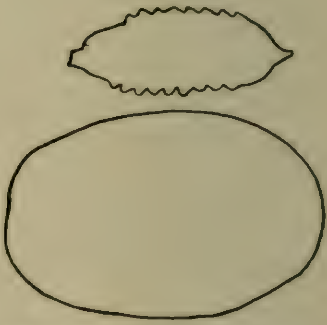


FIG. 24.—Outlines of Besser Haloo seed and fruit. (Natural size.)

This is a common and highly esteemed variety in the Jerid, and is said to be found also in the Nefzaoua, as well as at Biskra and in the Oued Rirh, in Algeria. It is one of the kinds that is most sought by the nomads of the interior, who come to the oases in the autumn to exchange their grain for dates. It is a small, light-colored date, with thick, comparatively firm flesh. It is very sweet and has an agreeable flavor, somewhat intermediate between that of Lagoo (p. 80) and that of Horra (p. 71). The natives seem to prefer it when not perfectly ripe. It matures early in October. According to information obtained by M. Minangoin, it yields a good crop every year and is one of the six most productive varieties of the Jerid. At Nefta the amins (see p. 32) rank it among the four most salt-resistant varieties of the oasis. Of this variety 18 offshoots were imported, all from the Jerid.

Okht Fteemy (p. 102).—The French orthography is Oukht Ftimi. The name means "sister of Fteemy," this variety greatly resembling Fteemy in its trunk and foliage characters, as well as in its fruits. Fruit 2 to 2⅙ inches long, about two-fifths as wide, oblong, straight, somewhat pointed at the apex, deep purplish maroon when ripe, the surface shining; the flesh 2½ to 3 lines thick, soft; the seed slender, about one-half as long as the fruit, less than one-third as wide as long, dark brown. (Fig. 25.) The stalks and branches of the fruit clusters are rich orange. The numerous leaves are long and broad, crowded with long leaflets. The many fruit clusters are short-stalked and almost hidden by the foliage.

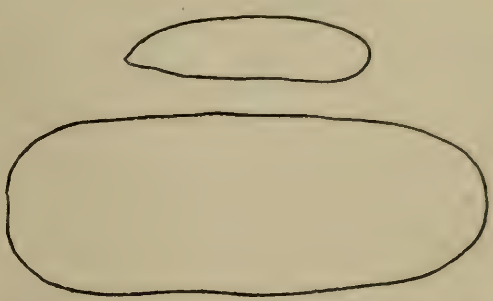


Fig. 25.—Outlines of Okht Fteemy seed and fruit. (Natural size.)

This variety appears to be confined to the Jerid, being especially abundant at Nefta, where it is preferred to Fteemy, while at Tozer the latter is better liked. The very handsome fruit is longer and more slender than that of Fteemy (p. 68), and is often brighter colored, but is otherwise very similar. In regard to flavor, the writer could detect no difference. Although very soft and sirupy, the fruits preserve well, Okht Fteemy being enumerated by one authority among the seven best-keeping sorts. The fruits are said to be the kind most in demand by the nomads from other parts of North Africa who obtain their supply of dates in the Jerid, and who exchange 4 measures (about 2½ pecks) of wheat for 9 measures (about 5½ pecks) of dates of this variety.

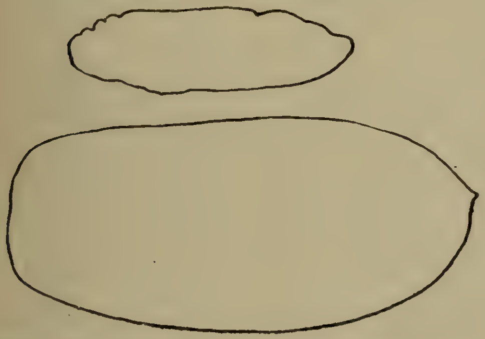


Fig. 26.—Outlines of Rhars seed and fruit. (Natural size.)

Okht Fteemy palms give a good crop every year and are very productive, this being among the six best-yielding varieties in the Jerid, according to M. Minangoin. A tree at Nefta, by no means exceptionally productive, which had 15 well-furnished clusters of fruit, was estimated by the tenant of the garden in which it grew to bear at least 220 pounds of fruit. These dates are not generally ripe before November. The amins of Nefta place this among the four most alkali-resistant varieties of the oasis. Offshoots to the number of 21 were imported.

Rhars (p. 102).—Also known as Rhars (or Ghars or Gheress) Mettigui. Fruit $1\frac{2}{3}$ to over 2 inches long, two-fifths to nearly one-half as wide, oblong or inversely egg-shaped, bay colored when ripe, the surface somewhat shining; the flesh 2 to 4 lines thick, very soft; the slender seed about three-fifths as long as the fruit, not more than one-third as wide as long, broad and rounded at both ends. (Fig. 26.) The ripe fruit does not keep its shape well when preserved. The stalks and branches of the fruit clusters are bright orange. The trunk is stout and the foliage luxuriant, the numerous long leaves being crowded with long, broad leaflets.

This variety, so abundant and so important in the oases of eastern Algeria, is rare in Tunis, its place being taken by varieties such as Fteemy and Okht Fteemy. (See pp. 68 and 79.) While the latter, however, are among the latest ripening kinds, Rhars is one of the earliest. It is said by Masselot to begin to ripen in the Jerid as early as the end of July. The fruit is large, bay colored when ripe, with copious, soft, sirupy, translucent flesh, very sweet and rich flavored. Although not one of the best-keeping sorts, it is preserved by natives in skins for use during the winter. No offshoots of this variety were imported from Tunis, as the Department of Agriculture had previously introduced large numbers from Algeria.

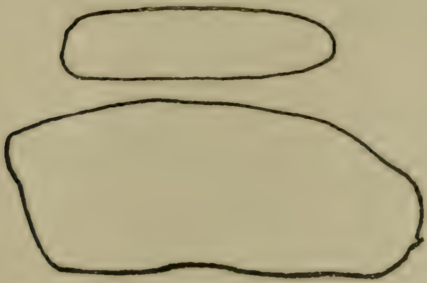


Fig. 27.—Outlines of Lagoo seed and fruit. (Natural size.)

Lagoo (p. 102).—Fruit nearly 2 inches long, less than one-half as wide, oblong, tapering slightly to the apex, more or less curved, bay to light maroon colored when ripe, the surface somewhat shining; the flesh about 2 lines thick, rather tough, dark colored; the seed slender, three-fifths to two-thirds as long as the fruit, not more than one-third as wide as long, russet brown, its surface roughened with fine wrinkles. (Fig. 27.) The stalks and branches of the fruit clusters are orange colored. The crown of foliage is rather small, the leaves short and rather stiff, with long, rather wide leaflets. The short, densely crowded fruit clusters do not equal the leafstalks. (Pl. VI, fig. 2.)

This variety is apparently confined to the Jerid oases, where it is fairly common and is highly esteemed by the natives. It is one of the earliest kinds, being said to ripen by the middle of September, and even (according to Masselot) in August. The fruit is of medium length, narrow, and is dark colored when ripe. The flesh is rather thin, but soft, very sweet, and of an agreeable, characteristic flavor, somewhat resembling the Rhars variety. It keeps well and is exported throughout Tunis and Algeria. Of this variety 23 offshoots were imported.

Zekry (p. 103).—Also spelled "Zechri." Fruit $1\frac{1}{2}$ to nearly $1\frac{2}{3}$ inches long, about one-half as wide, inversely egg-shaped, keeping its shape fairly well when preserved, bay to maroon when ripe; the flesh about $1\frac{1}{2}$ lines thick, moderately soft; the seed between one-half and two-thirds as long as the fruit, about two-fifths as wide as long. (Fig. 28.) The stalks and branches of the fruit clusters are orange colored.

This variety, infrequent in the Jerid, is common in the Nefzaoua, where it is in high repute. When perfectly ripe the flesh, although rather thin, is soft and very sweet. The flavor is characteristic, suggesting both chestnuts and persimmons. The palms are said to yield heavily. Of this interesting variety 11 offshoots were imported, all from the Nefzaoua.

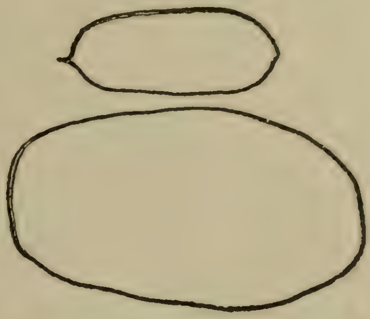


Fig. 28.—Outlines of Zekry seed and fruit. (Natural size.)

Khalt Mooashem (p. 104).—The name means "tattooed Khalt."[a] Fruit $1\frac{2}{3}$ to nearly 2 inches long; about one-half as wide, egg-shaped, narrowed from about the middle to the rounded apex, keeping its shape perfectly when preserved, dark prune purple when ripe, the skin mostly adhering very closely to the flesh, conspicuously marked with transverse and longitudinal scars (hence the name); the flesh about 2 lines thick, firm yet tender; the seed about one-half as long as the fruit, nearly one-half as wide as long, broadest near the middle, light brown, rough. (Fig. 29.) The branches of the fruit clusters are bright orange.

A rare variety of the Jerid. The excellent fruit is characterized by its dark prune color, curiously scarred skin, copious flesh, and very sweet, highly attractive flavor. It apparently keeps perfectly. Thirteen offshoots were imported.

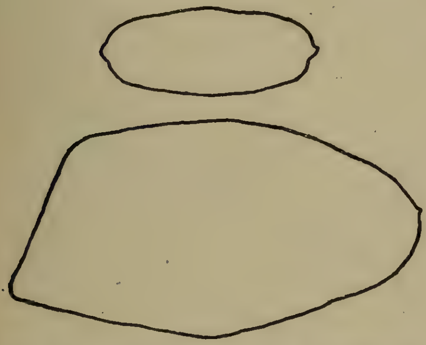


Fig. 29.—Outlines of Khalt Mooashem seed and fruit. (Natural size.)

Khalt Deglaowia (p. 104).—The name signifies "Khalt resembling a Deglet (Noor)." Fruit $1\frac{2}{3}$ to $1\frac{3}{4}$ inches long, about one-half as wide, egg-shaped, narrowed from about the middle to the rounded apex, keeping its shape well when preserved, dark maroon purple when ripe, much of the skin loosened into soft blisters, the flesh about 2 lines thick, firm yet tender; the seed about two-fifths as long as the fruit, about one-third as wide as long, cinnamon brown. (Fig. 30.) The stalks and branches of the fruit clusters are light yellow (not orange).

---

[a] Although the word "khalt" is generally defined as meaning a dry date, most of the "khalts" of the Jerid oases which have received special names are soft dates and often of excellent quality.

This variety occurs apparently only at Nefta, and is not common there. The fruit is rather small, with fairly thick, firm flesh. The fine flavor suggests that of the Deglet Noor, which it resembles also in the shape of the fruit and the maize-yellow color of the branches of the clusters. Of this rare variety only two offshoots could be procured.

Khalt Horraowia (p. 105).—The name means "Khalt resembling Horra." Fruit 1⅞ to over 2 inches long, narrowed from near the base to the somewhat pointed apex, keeping its shape well when preserved, dark maroon purple when ripe; the flesh 2 to 3 lines thick, firm yet tender, very sugary; the seed about one-half as long as the fruit, about one-third as wide as long. (Fig. 31.) The branches of the fruit clusters are orange colored. The crown of foliage is well developed, the leaves large and the leaflets long and numerous.

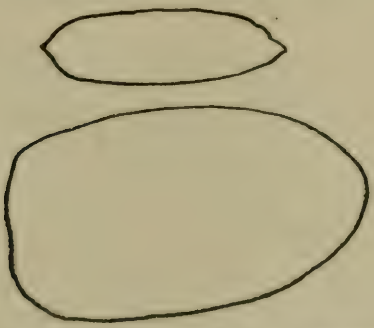


Fig. 30.—Outlines of Khalt Deglaowia seed and fruit. (Natural size.)

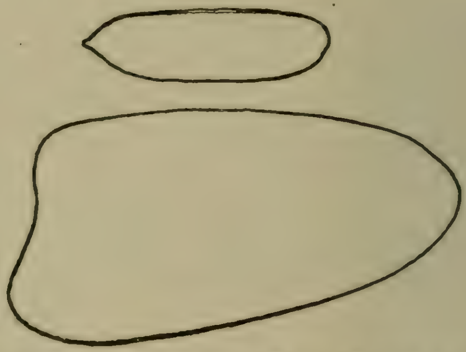


Fig. 31.—Outlines of Khalt Horraowia seed and fruit. (Natural size.)

A fine variety of the Jerid, by no means common. The large, handsome fruit somewhat resembles that of Horra (see p. 71), both in appearance and flavor. The flesh is copious, firm yet tender, and contains a great deal of sugar. Six offshoots were obtained.

VARIETIES OF MINOR IMPORTANCE.

DRY DATES.

Bayjoo (p. 97).—French orthography, Badjou. Fruit 1⅓ inches long, about two-thirds as wide, egg-shaped, purplish maroon or bay colored when ripe; the flesh 1½ lines thick; the seed nearly two-thirds as long as the fruit, one-half as wide as long, light brown. (Fig. 32.) The stalks and branches of the fruit clusters are pale orange colored. The leaves are numerous, short but with long stalks and rather stiff; the leaflets long and broad but rather sparse. The small, dense bunches of fruit hang down on long curved stalks.

Abundant in the Jerid, and occurs also in the Nefzaoua. It is one of the varieties most widely exported to other parts of Tunis and Algeria. Flavor nutty, agreeable, but not very characteristic, typical of the dry date class. Matures in October (the 20th, according to Masselot). Number of offshoots imported, 7, all from the Jerid.

Remta (p. 98).—Also spelled Remtsa (probably a misprint). Fruit 1½ to 1⅝ inches long, about one-half as wide, oblong, somewhat pointed (bluntly) at the apex, generally distinctly constricted a little above the base, dark maroon colored when ripe; the flesh about 1 line thick, rather tough; the seed one-half to two-thirds as long as the fruit, a little less than one-half as wide as long. (Fig. 33.) The stalks and branches of the fruit clusters are bright orange.

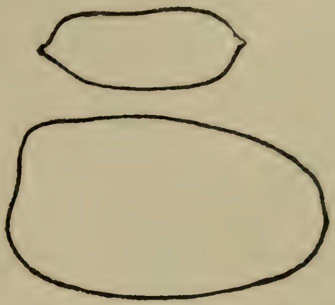


Fig. 32.—Outlines of Bayjoo seed and fruit. (Natural size.)

Occurs in the Jerid, especially at El Hamma, but appears to be uncommon. Is readily distinguished from other dry dates by being generally distinctly constricted a little above the base; hence resembling Boo Fagoos (see p. 67) in shape. Flesh firm, moderately sweet, with an agreeable flavor resembling that of Thaby (see p. 75), to which this variety appears to be closely related. Said to ripen early (in October) and not to be injured by autumn rains. Number of offshoots imported, 10.

Hamra (p. 98).—The name means "red." Sometimes called Hamraia (referring to the tree rather than the fruit).[a] Fruit 1½ to 2 inches long, about one-half as wide, egg-shaped, tapering from near the base to the rounded apex, bright purplish maroon when ripe, the colors very handsome; the flesh 1 to 3 lines thick, becoming quite firm, the dark-colored outer zone thicker than the white central portion; the seed two-thirds to four-fifths as long as the fruit, generally about two-fifths as wide as long, sometimes with strongly developed wing-like ridges on the sides. (Fig. 34.) The stalks and branches of the fruit clusters are orange colored.

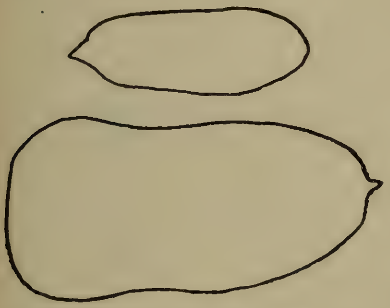


Fig. 33.—Outlines of Remta seed and fruit. (Natural size.)

Fairly common in the Jerid and the Nefzaoua, occurring also in Algeria. Is one of the largest and most showy of the dry dates. Much resembles Horra (see p. 71) and surpasses it in brightness of color, but is decidedly inferior to it in flavor. Ripens in the latter part of October and the beginning of November. Is not much esteemed by the natives. Said to keep well, having been enumerated at Kebili among the seven best preserving sorts. Number of offshoots imported, 4, all from the Jerid.

---

[a] Hamra Bischry (or Bechry) is said by some of the natives of the Jerid to be identical with Hamra, although described in Algeria as a soft date. The "Hamraya" of the Mzab oases is also described as a soft date.

KENTEESHY (p. 99).—Also spelled Kentichi. Is known in Algeria as M'Kentichi Degla. Fruit about 1½ inches long, slightly more than one-half as wide, oblong or slightly inversely egg-shaped, dull bay when ripe, the skin remaining yellow; the flesh, 1 to 2½ lines thick, becoming hard and dry; the seed about two-thirds as long as the fruit, one-third to two-fifths as wide as long, broad and rounded at both ends. (Fig. 35.) The stalks and branches of the fruit clusters are dull orange. The palm is strong and vigorous, with coarse, heavy foliage, long leaves and numerous but rather distant long and broad leaflets. The stalks of the fruit clusters are curved, forming nearly a semicircle, but do not hang down below the foliage.

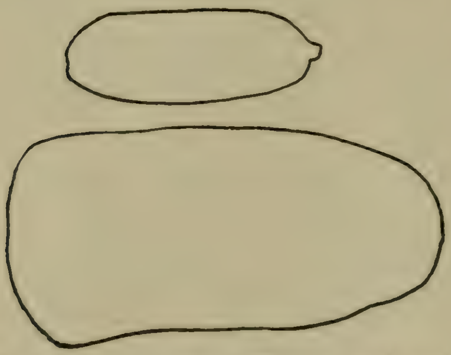


FIG. 34.—Outlines of Hamra seed and fruit. (Natural size.)

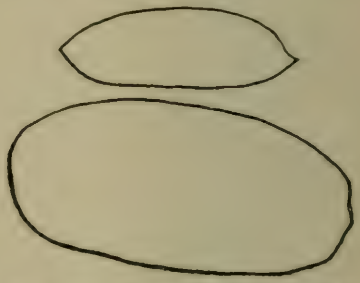


FIG. 35.—Outlines of Kenteeshy seed and fruit. (Natural size.)

Fairly common in the Jerid and much esteemed by the natives, who are reluctant to part with offshoots, notwithstanding the fact that the fruit is small, thin of flesh, and becomes hard and dry almost before it has lost its astringency. It ripens toward the end of October and beginning of November. It is moderately sweet and rather tasteless. It yields heavily, being one of the most productive varieties found in Tunis, and is said to give a good crop every year. It is reputed to be very alkali resistant, but to require plenty of water. Kenteeshy is said to thrive in poor soils where other varieties will not grow and to be often planted as a wind-break. Number of offshoots imported, 11, all from the Jerid.

SOFT DATES.

TANTABOOSHT (p. 99).—French orthography, Tantaboucht. Fruit nearly spherical, usually somewhat wider than long, 1 to 1¼ inches in greatest diameter, usually widest above the middle, slightly depressed at apex, not keeping its shape well when preserved, very dark brown purple (almost black) when ripe; the flesh 3 to 5 lines thick, very soft and dark colored; the large seed two-thirds to four-fifths as long as the fruit, one-half to two-thirds as wide as long, smooth. (Fig. 36.) The stalks and branches of the fruit clusters are deep orange colored.

Rare in the Jerid, common in Algeria. A date remarkable for its round shape and very soft, almost black flesh. Flavor peculiar and characteristic, even perfectly ripe fruit retaining a certain amount of astringency. Number of offshoots imported (from the Jerid), 5.

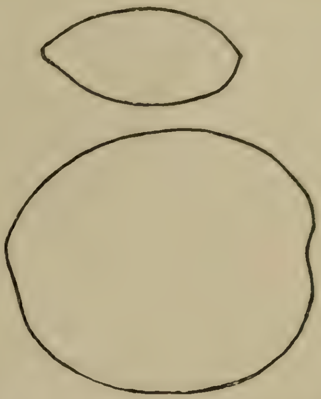


FIG. 36.—Outlines of Tantaboosht seed and fruit. (Natural size.)

TOZER ZAID SAFRA [a] (p. 100).—Fruit $1\frac{1}{2}$ to $1\frac{2}{3}$ inches long, one-half to two-thirds as wide as long, oblong or oblong egg-shaped, widest near the middle, broad, and rounded at apex, not keeping its shape well when preserved; the flesh $1\frac{1}{2}$ lines thick, extremely soft and sirupy, nearly black; the relatively large seed about one-half as long as the fruit, two-fifths to one-half as wide as long, light brown. (Fig. 37.) The leaves are long and very numerous, with short stalks, almost concealing the fruit clusters.

Common in the Jerid. Flavor characteristic, resembling that of Baydh Hammam (p. 76), not attractive to the writer, but much appreciated by the natives. Generally eaten fresh, but sometimes preserved for a short time in skins. Yields heavily. Fruit ripens in the latter part of October. Said at Nefta to be one of the four most salt-resistant varieties. Number of offshoots imported, 9.

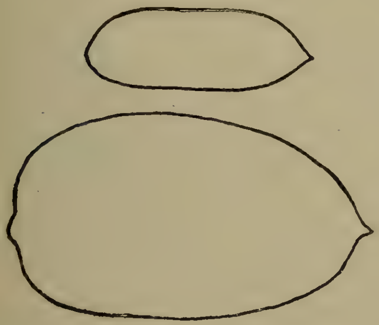


FIG. 37.—Outlines of Tozer Zaid Safra seed and fruit. (Natural size.)

TOZER ZAID KHALA [b] (p. 100).—Fruit $1\frac{1}{2}$ to $1\frac{3}{4}$ inches long, three-fifths to two-thirds as wide, inversely egg-shaped or oblong, broad and rounded at apex, not keeping its shape well

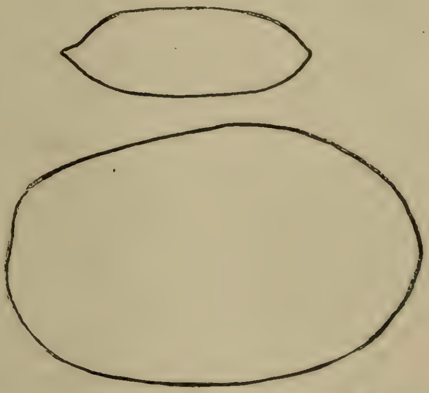


FIG. 38.—Outlines of Tozer Zaid Khala seed and fruit. (Natural size.)

---

[a] The very similar name "Taser Seit" is applied to a variety occurring in the Mzab oasis.

[b] Said to be known as Abdul Aziz (or Abd-el-Azaz) in the Oued Souf. A variety of the latter name occurs in the Oued Rirh.

when preserved; black when ripe; the flesh about 2 lines thick, very soft and sirupy, nearly black; the seed about two-fifths as long as the fruit, about two-fifths as wide as long, dark brown. (Fig. 38.)

Less common than the Tozer Zaid Safra variety, which it very closely resembles in appearance and flavor. Number of offshoots imported, 7.

Sayba Boo Dra (p. 102).—Fruit from 2 to more than 2½ inches long, less than one-half as wide, oblong, somewhat pointed at the apex, usually curved, prune purple when ripe, the surface rather dull; the flesh 3 to 3½ lines thick, rather firm; the slender seed about one-half as long as the fruit and not more than one-third as wide as long. (Fig. 39.) The stalks and branches of the fruit clusters are bright orange colored.

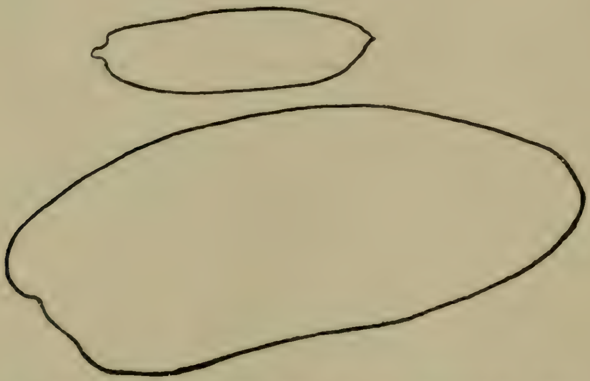


Fig. 39.—Outlines of Sayba Boo Dra seed and fruit. (Natural size.)

In Tunis apparently confined to the Jerid oases, where it is rare. Occurs also in the Oued Rirh in Algeria. The name signifies that, turned over endwise seven times, the fruit measures a cubit (20 inches), and is expressive of the great length of this huge date, the largest of the Tunisian varieties. Flesh thick, rather tough. Flavor agreeable, suggesting Boo Fagoos (see p. 67). It ripens about the end of October. Number of offshoots imported, 10.

Kharooby (p. 102).—French orthography, Kharroubi. Fruit about 2 inches long, less than two-fifths as wide, often wider near the apex than elsewhere, usually curved, between bay and maroon colored when ripe, the surface shiny; the skin conspicuously loosened and remaining light yellow; the flesh 1 to 2 lines thick, rather soft and dark colored; the seed nearly three-fifths as long as the fruit, one-third as wide as long, generally somewhat curved. (Fig. 40.) The stalks and branches of the fruit clusters are orange colored. The leaves are very long, crowded with long, broad leaflets.

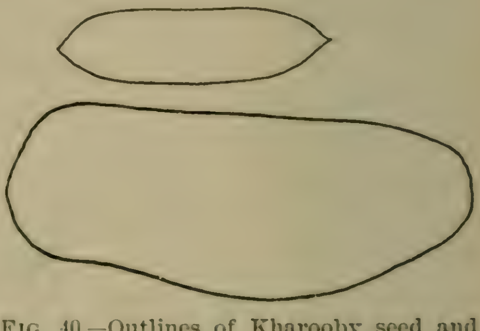


Fig. 40.—Outlines of Kharooby seed and fruit. (Natural size.)

Frequent, but not abundant, in the Jerid. Flesh of the ripe fruit of the consistency of thick jelly, moderately sweet, agreeable in flavor, resembling Lagoo (see p. 80). Said to preserve well. Ripens in October. The offshoots remain small while attached to the parent tree. Number of offshoots imported, 2.

Gasby (p. 102).—Fruit about 2 inches long, about two-fifths as wide, oblong, often conspicuously curved, very dark prune purple with a conspicuous bloom when ripe, the surface dull, the skin tough, russet brown where loosened from the flesh; the flesh 1 line thick, dark colored, remaining soft; the slender seed not more than three-fifths as long as the fruit, not more than one-third as wide as long, russet brown, often curved. (Fig. 41.) The stalks and branches of the fruit clusters are deep orange colored. The crown of foliage is rather small and delicate, the leaves short, relatively long stalked, the leaflets long. The offshoots remain small while attached to the parent tree.

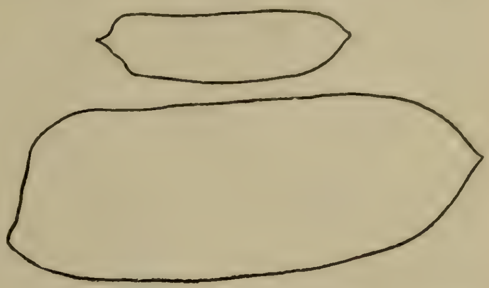


Fig. 41.—Outlines of Gasby seed and fruit. (Natural size.)

Common in the Jerid. Ripens very early, next after Ammary (see below), it is said; at the end of July, according to Masselot. A handsome, long, slender, dark-colored, generally curved date. Highly esteemed by some of the natives, while others say it is used mostly for making puddings and confectionery. The writer found its flavor, which is of the Lagoo type (see p. 80), rather attractive, suggesting that of raisins. It is said to keep very well. Number of offshoots imported, 19.

Bent Segny (p. 103).—Fruit $1\frac{3}{4}$ to $1\frac{7}{8}$ inches long, about one-half as wide, inversely egg-shaped, square at base, rounded at the apex, keeping its shape poorly when preserved, very dark (almost black) purplish brown when ripe; the flesh $1\frac{1}{2}$ lines thick, very dark colored and very soft; the seed about one-half as long as the fruit, two-fifths to one-half as wide as long, rounded at both ends. (Fig. 42.) The stalks and branches of the fruit clusters are deep orange colored.

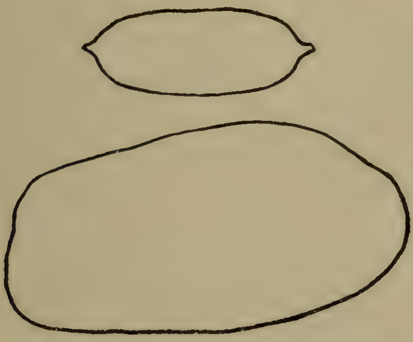


Fig. 42.—Outlines of Bent Segny seed and fruit. (Natural size.)

Rather rare in the Jerid. A very soft, sirupy date, with a pleasant but not remarkable flavor. Ripens about the end of October. Number of offshoots imported, 3.

Ammary (p. 103).—Fruit $1\frac{1}{4}$ to a little over $1\frac{1}{2}$ inches long, about one-half as wide, generally inversely egg-shaped, square at the base, rounded at the apex, keeping its shape fairly well when preserved; dark brown purple when ripe; the flesh 1 to $1\frac{1}{2}$ lines thick, very soft and dark colored; the seed about two-thirds as long as the fruit. about two-fifths as wide as long, blunt at both ends. (Fig. 43.) The stalks and branches of the fruit clusters are orange colored. Foliage coarse and heavy, leaves very numerous, rather short stalked, with long, wide leaflets.

Common in the Jerid, the Nefzaoua, at Gabes, and in Algeria. Is the earliest maturing variety in Tunis, ripening in the Jerid in August (or even the middle of July, according to Masselot), and from September 1 to September 15 at Gabes. Said to give a good crop every year, and to be very productive. Fruit of rather mediocre quality. Number of offshoots imported, 12, all from the Jerid.

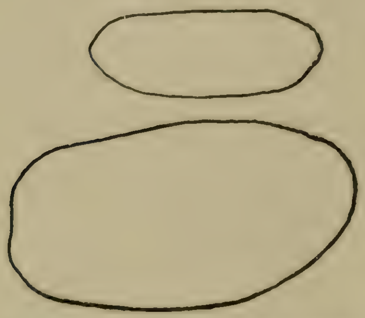


Fig. 43.—Outlines of Ammary seed and fruit. (Natural size.)

Goondy (p. 103).—Fruit about $1\frac{2}{3}$ inches long, about one-half as wide, inversely egg-shaped, oblong (broadest above the middle), keeping its shape fairly well when preserved, bay to maroon colored when ripe; the flesh about $1\frac{1}{2}$ lines thick, dark colored, remaining rather soft; the seed more than one-half as long as the fruit, about one-third as wide as long. (Fig. 44.) The stalks and branches of the fruit clusters are bright orange colored. Foliage rather coarse, the leaves very numerous, short, and rather short stalked, the leaflets long and broad.

Rather common in the Jerid, and said to occur also in the Nefzaoua and at Biskra, in Algeria. Sweet and of agreeable but not pronounced flavor, of the Lagoo type. (See p. 80.) Ripens in the Jerid on October 20, according to Masselot, although the writer was told that it ripens sometimes as early as September 15. The fruit is preserved in skin bags for home use, but is not an article of commerce. Number of offshoots imported, 9, all from the Jerid.

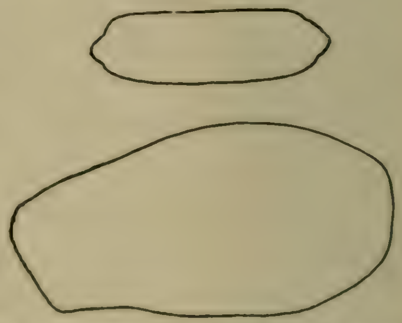


Fig. 44.—Outlines of Goondy seed and fruit. (Natural size.)

Karooy (p. 104).—Fruit $1\frac{2}{3}$ inches long, about one-half as wide, egg-shaped, narrowed from near the base to the rounded apex, keeping its shape fairly well when preserved, bay colored when ripe; skin, where loose, olive-brown; the flesh about $1\frac{1}{2}$ lines thick, rather tough; the seed more than one-half as long as the fruit, about one-third as wide as long. (Fig. 45.) The branches and stalks of the fruit clusters are orange colored.

A variety found in the Jerid, but not common. The name is not given in any published list of the varieties. Flesh rather tough, moderately sweet, flavor agreeable, similar to that of the dry dates. Number of offshoots imported, 5.

Tenaseen (p. 105).—French orthography, Tanessin or Tenassine.) Fruit $1\frac{2}{3}$ to $1\frac{7}{8}$ inches long, about one-half as wide, oblong, not keeping its shape well when preserved, black when ripe; the flesh very soft, nearly black; the seed about three-fifths as long as the fruit, about one-third as wide as long, rather dark brown.

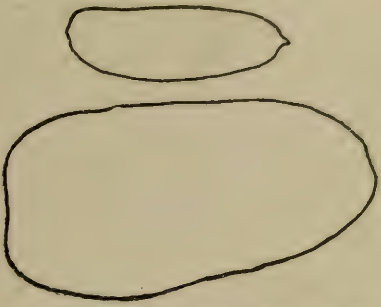


Fig. 45.—Outlines of Karooy seed and fruit. (Natural size.)

Rare in the Jerid, common in the Oued Souf and Oued Rirh in Algeria. The flavor of the very sweet, soft, dark-colored flesh suggests Tozer Zaid Safra (see p. 85), but is more agreeable. Is said to ripen in October. Crown of foliage horizontal, umbrella-like. One offshoot imported from the Jerid.

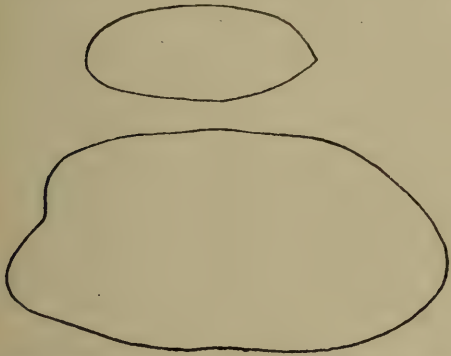


Fig. 46.—Outlines of Iteema seed and fruit. (Natural size.)

Iteema (p. 106).—(French orthography, Ytima.) The name means "an orphan girl." Fruit slightly more than 2 inches long, about one-half as wide, widest at or near the middle, rounded at base, somewhat pointed and conspicuously not symmetrical at apex, not keeping its shape well when preserved, chestnut brown, with a slight purple tinge when ripe, the surface shiny; the flesh over 2 lines thick, extremely soft; the seed nearly one-half as long as the fruit, about two-fifths as wide as long, chestnut colored. (Fig. 46.)

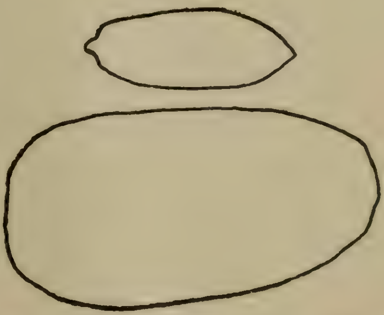


Fig. 47.—Outlines of Khalt Hameed seed and fruit. (Natural size.)

Rare in the Jerid, common in the Algerian oases. A very handsome date, with sirupy, translucent flesh, extremely sweet, rather insipid in flavor. An early ripening sort, maturing in the Jerid at the end of September (according to Masselot). Eaten fresh. Number of offshoots imported, 15 (2 only from Tunis, the rest from Algeria).

Khalt Hameed (p. 106).—Fruit $1\frac{2}{3}$ inches long, about one-half as wide, elliptical in form, generally slightly narrowed at both ends, keeping its shape well when preserved, bright maroon when ripe; the flesh $1\frac{1}{2}$ lines thick, rather firm, not very sugary; the seed smooth, more than one-half as long as the fruit, about two-fifths as wide as long, widest above the middle. (Fig. 47.)

Occurs in the Jerid, but is not common. Said to be much liked by the natives when not perfectly ripe, but to the writer the flavor seemed inferior. Ripens at the end of October. Does not keep. Number of offshoots imported, 6.

VARIETIES IMPORTED BUT NOT INCLUDED IN THE KEY.

Deglet Barca.—Occurs in the Jerid, but is not common. Fruit not seen by the writer, but said to be round, of the same color as Tozer Zaid Safra (p. 85) (very dark brown, almost black), but different in flavor. It is described as a R'tob (soft date) that preserves very well. Number of offshoots imported, 7.

Deglet Caid.—Rare in the Jerid, and said to occur also in the Oued Rirh. Fruit not seen by the writer, but said to be coral red before maturity and black when ripe, and to be conservable only for a short time. Reported to be a fine variety, and to ripen early in September. Number of offshoots imported, 2.

Deglet Sennayga.—Occurs in the Jerid; not common. A soft date. Fruit about 1½ inches long, nearly one-half as wide, oblong, somewhat pointed at the apex, bright chestnut brown when ripe, surface shiny; skin much loosened and folded; flesh soft, dark colored; seed large, dark brown. Said to ripen early in October. Very sweet, flavor distinctive (suggesting burnt sugar) and rather agreeable, but not very pronounced. It is said to keep well. The offshoots remain small as long as they are attached to the parent tree. Number of offshoots imported, 9.

Gasb Haloo.—(Name spelled phonetically, as pronounced by the natives.) Occurs at Nefta. Is probably the same as the "Gsub (or Ksob) Halou" found in the Ziban and Oued Rirh oases of Algeria. Fruit not seen by the writer. Said to resemble Kenteeshy (p. 84) in color; described as sweeter and better flavored than Gasby (p. 87). Number of offshoots imported, 3.

Guern-el-Rhezal.—(Gazelle's Horn.) One of the principal varieties in the Gabes region and on the island of Jerba, occurring also at Biskra and in the Oued Rirh, Algeria, but rare in the Jerid. Fruit not seen by the writer. It is described by M. Minangoin as long, slender, and curved. The amins at Gabes say it is not a very good date, the stone being large and the flesh thin. "It has more bones than flesh," as they express it. This is said, however, to be one of the three varieties chiefly preserved at Mettoui, near Gabes, requiring first to be dried. Number of offshoots imported, 4.

Khadraya.—Name signifies "green." Occurs in the Jerid, but apparently is not common. A variety of the same name, but perhaps not identical, is found in Algeria. Belongs to the dry date class.

Fruit about 1½ inches long, about one-half as wide; oblong, narrowed at the apex, bright orange before maturity, dull light brown when ripe; seed large, light brown; branches of fruit clusters bright orange. Very sweet and with a pleasant flavor, suggesting Halooa Bayda (see p. 75). Ripens in October. Number of offshoots imported, 5.

Khalt Boo Fagoos.—A rare variety of the Jerid. Fruit of the soft type, very similar to that of Boo Fagoos (see p. 67), about 1⅔ inches long, 1 inch wide, generally more or less obovate, maroon colored when ripe, skin much blistered; flesh very firm; seed large; branches of fruit clusters light orange. Moderately sweet, with a fine flavor of the Horra type (see p. 71). Number of offshoots imported, 4.

Khalt Gama.—Occurs at Nefta. Fruit not seen by the writer. "Gama" means wheat, and the name is said to refer to the color of the fruit. Number of offshoots imported, 2.

Khalt Kebeer.—A variety of the Jerid, apparently not common. A fine, large, reddish brown, soft date, with small seed, preserving admirably. Flavor excellent, considered by the natives to resemble that of Boo Fagoos (see p. 67). Is a promising variety. Number of offshoots imported, 11.

Khalt Kentaowia.—Occurs in the Jerid; apparently not uncommon at Tozer. Fruit not seen by the writer. The foliage is well developed and handsome, the leaves very numerous, crowded with long leaflets. The name implies a resemblance to the Kenta variety (p. 72). Number of offshoots imported, 4.

Okht Ammary.—A variety of the Jerid, probably not common. Fruit not seen by the writer. Said to resemble Ammary (see p. 87), but to be larger. Reported to ripen at the end of September, and not to keep well. One offshoot was imported.

Sba Aroossa.—Name means "bride's fingers." Occurs in the Jerid, and also reported to occur in the Ziban oases, in Algeria. Is said to be rare and of fairly good quality. Fruit not seen by the writer. Reported to be a long, slender date, ripening in October and not keeping well. Number of offshoots imported, 6.

Towadant.—Occurs at Nefta, and is probably rare. Fruit not seen by the writer; said to be very large and long, yellow, and of good flavor, ripening at the same time as Fteemy, and keeping well. Number of offshoots imported, 4.

Zrai.—Name spelled phonetically as pronounced by the natives, not having been found in any published list. Occurs at Nefta. Fruit not seen by the writer; said to resemble Deglet Noor (p. 63) in color. Number of offshoots imported, 7.

VARIETIES INCLUDED IN THE KEY BUT NOT IMPORTED.

CHEDAKH (p. 106).—Is of the soft type. Fruit nearly 2 inches long, about one-half as wide, oblong, narrowed slightly at both ends, keeping its shape fairly well when preserved, purplish maroon when ripe; the flesh only 1 line thick, all of it soft and dark colored; the seed about three-fifths as long as the fruit and about one-third as wide as long. (Fig. 48.) The leaves are rather short, and the fruit clusters loose and open, with rather short, erect or ascending stalks.

Common in the Jerid, and said also to occur in the Nefzaoua. Is a "R'tob," the fruit being eaten fresh and not preserved. It is not highly esteemed by the natives, and the flavor is uninteresting. Ripens toward the end of October.

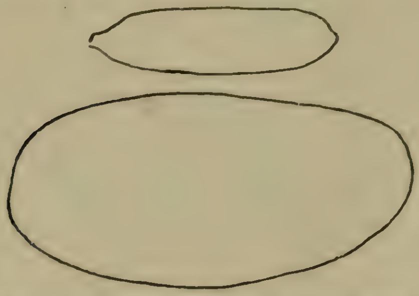


FIG. 48.—Outlines of Chedakh seed and fruit. (Natural size.)

DEGLET HAMIDATOO (p. 105).—Fruit of the soft type, about 2 inches long, about one-half as wide, somewhat blunt pointed at the apex, elliptical, not keeping its shape well when preserved, light hazel brown when ripe; the flesh 2½ lines thick, very soft and sirupy, translucent; the seed about one-half as long as the fruit, about one-third as wide as long, russet to chestnut colored. (Fig. 49.) The foliage is very well developed, the leaves numerous and long, crowded with long leaflets, the bunches of fruit rather loose and open, with ascending or spreading stalks.

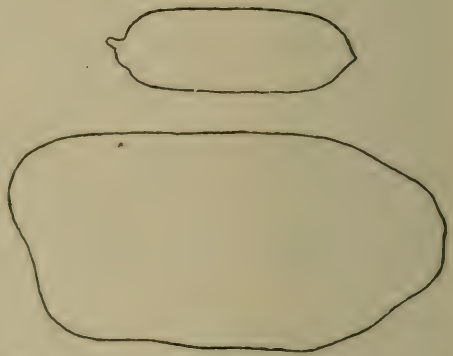


FIG. 49.—Outlines of Deglet Hamidatoo seed and fruit. (Natural size.)

A very rare variety of the Jerid, said to be represented at Tozer by only two trees. Reported to occur also in the oasis of Negrine, Algeria. It is said to be eaten only when fresh and not to be conservable. The fruit is of splendid appearance, beautifully colored, and extremely soft and sirupy when ripe. Although very sweet and rich, the flavor is rather insipid and soon cloys, like the Iteema (p. 89). Ripens in the latter part of October.

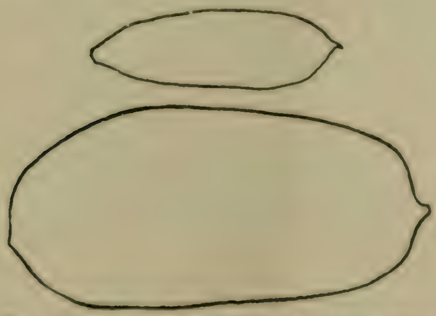


FIG. 50.—Outlines of Deglet Hassen seed and fruit. (Natural size.)

DEGLET HASSEN (p. 103).—Fruit of the soft type, 1⅔ to 1¾ inches long, one-half as wide, inversely egg shaped, tapering slightly at both extremities, not keeping its shape well when preserved, bright bay colored when ripe; the skin, where loose, yellow; the flesh about 1½ lines thick, extremely soft, light colored, translucent: the slender seed about three-fifths as long as the fruit, not more than one-third as wide as long. (Fig. 50.) The trunk is slender, the leaves numerous, short, and comparatively long-stalked.

Said to be widely distributed in the Jerid, although the writer failed to secure offshoots. The offshoots are said to be worth 75 cents to $1.15 apiece, a price that would indicate this to be a highly esteemed variety. The fruit, said to be eaten only when fresh, is extremely soft and very sweet and rich, but soon cloys. Ripens in October.

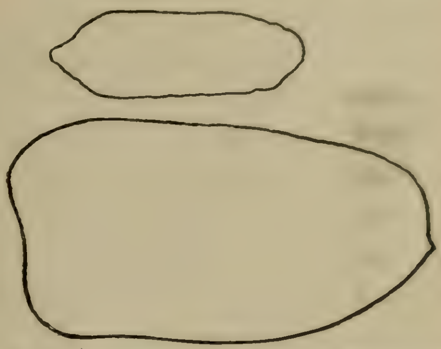


FIG. 51.—Outlines of Khalt Menakhry seed and fruit. (Natural size.)

KHALT MENAKHRY (p. 105).—The name signifies a "Khalt resembling Menakher."[a] Fruit of the soft type, from nearly to more than 2 inches long, about one-half as wide, egg-shaped, narrowed from about the middle to the broad, rounded apex, keeping its shape well when preserved, dark purplish maroon when ripe; the flesh 2 to 3 lines thick, firm, yet very sugary; the seed about one-half as long as the fruit, about two-fifths as wide as long, blunt at both ends. (Fig. 51.) The stalks and branches of the fruit clusters are light orange colored.

Occurs at Nefta, in the Jerid, but is evidently very rare. The fine fruit very closely resembles Khalt Horraowia (p. 82) in appearance and flavor. Ripens in the latter part of October.

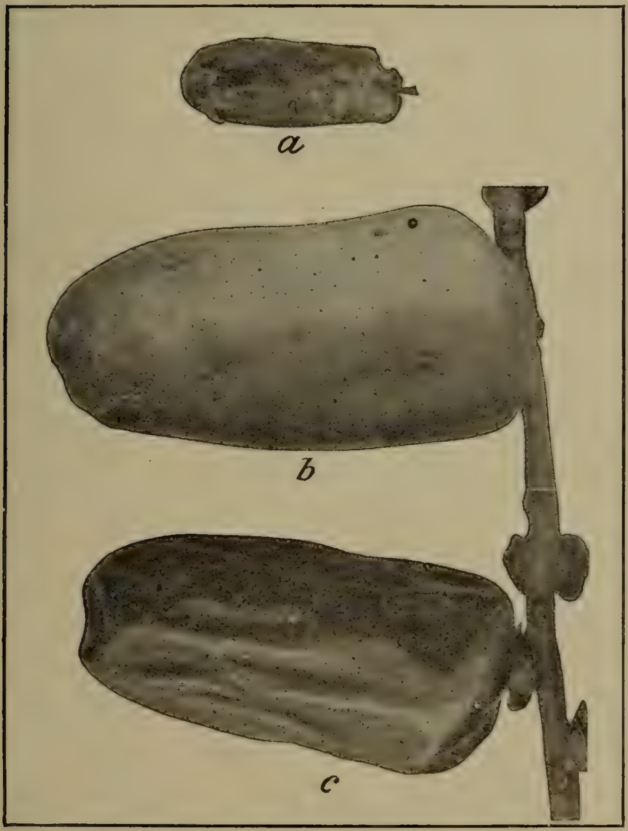


FIG. 52.—Selatny seed and fruits. (Natural size.)

SELATNY (p. 104).—Fruit of the soft type, over 2 inches long, about one-half as wide, tapering from near the base to the somewhat pointed apex, keeping its shape well when preserved, bright bay colored when ripe, the surface shining; the flesh 1½ lines thick, rather soft, translucent; the seed about one-half as long as the fruit, about two-fifths as wide as long, blunt at both ends, roughened with deep furrows near the base. (Fig. 52.) The stalks and branches of the fruit clusters are orange colored.

---

[a] See footnote, p. 81.

A rare variety of the Jerid; said also to occur in the Nefzaoua, and to be less rare there, although the writer saw no trees in the latter region. It is very highly esteemed by the natives and, although a special effort was made to obtain offshoots of this variety in the Jerid, none could be had. It is possible that an exhaustive search in the Nefzaoua region might result in obtaining offshoots. The fruit is of fine appearance and is said to be generally eaten fresh, although it can be preserved. The flavor somewhat resembles that of the Deglet Noor and is hardly inferior, while in size this variety compares favorably with the Menakher. It ripens in October (or even in September, according to Masselot). The palm has a stout trunk. The leaves are rather short and broad, with few spines. The stalks of the short fruit clusters are nearly horizontal and so short that together with the clusters they are hardly as long as the leafstalks. For the rarity of this variety the same explanation was given the writer as for that of Menakher (see p. 62).

DESCRIPTIVE KEY TO THE CHARACTERS OF THE FRUITS.

The characters given in the key of date varieties which follows were either noted on the spot from freshly gathered fruit or were subsequently worked out from samples and from natural-size photographs made in the field. In a few instances samples of fruit obtained in the autumn of 1905 at the cooperative date garden at Tempe, Ariz., from palms imported several years ago from Algeria, have also been used in making up the descriptions, such cases being always specifically mentioned. Owing to the scantiness of the material available in many cases, it is probable that the descriptions will have to be modified as we gain a better knowledge of the varieties.

In regard to measurements, width refers in every case to the greatest width of the fruit and the seed, thickness of flesh to the maximum thickness, and length of the stone is taken to exclude the apical point, or mucro, and the fibrous stipe. Color of the fruit, unless otherwise specified, refers to the parts where the skin adheres closely to the flesh. Where the skin has become loose in places, as in most of the soft dates when quite ripe, it has a lighter color, which is also generally described. The "germ pore" is a circular depression, 1 to 2 mm. in diameter, occurring on the back of the seed. When its position is not mentioned in the description it is understood that it occurs at or near the middle of the seed. The embryo is situated at this point and the shoot appears here at germination.

Much use has been made of the characters afforded by the colors of the fruit, seed, etc., the names of colors used being those given by Ridgway (Nomenclature of Colors for Naturalists, Boston, 1886). In order to facilitate comparison, each name of a color that occurs in the key is followed by a reference to the corresponding plate and figure in the work cited, thus: Maroon (IV, 2). The giant cells, to which the writer's attention was first called by Mr. W. T. Swingle, occur in a more or less sharply defined zone in the softer part of the flesh, close to the skin. It is really the hard, bright-colored, highly refractive masses of cell contents (probably consisting chiefly of tannins) that are here described. Their characters are taken only from thoroughly ripe fruit in which the cell contents have assumed their final shape, size, and color.

A word is necessary in regard to the form of the key. The varieties are divided, in the " Synopsis of the groups," first into two principal classes, the dry dates and the soft dates. Each group is then subdivided into a number of smaller groups. The designations selected for the two main groups should not be understood as implying that all the dry dates are necessarily hard and thin of flesh or that all the soft dates are rich and sirupy. While the extremes of the two types are very distinct, intermediate forms occur, which make it impossible to draw a hard and fast line between them. Exceptions occur in both categories, and some of the varieties of which the affinities are evidently with the first group have thicker and softer flesh than some of the varieties of the second group. In deciding to which of the two classes a given variety belongs, all of its characters must be taken into consideration. It should be explained that the classification, at least beyond the two main groups, is largely artificial, and is designed merely to aid in identifying the varieties. While in many cases it happens that several varieties that are undoubtedly closely related botanically are brought into juxtaposition in the key, this is by no means always the case.

The key to the varieties is not of the dichotomous form usually employed by systematic biologists, but is modeled upon that which was introduced by Mr. O. F. Cook in his studies of Myriapoda.[a] It has the advantage of eliminating one species (or variety) at every step. It will be noted that the whole key is arranged in pairs of paragraphs. Of each pair, the first paragraph describes a variety, and the second gives the characters which distinguish all of the same group which follow from the one that has just been separated out. Those characters in the first paragraph that are especially to be contrasted with the second paragraph are printed in italics, as is the second paragraph itself. The italicized portion, therefore, constitutes the key proper. Frequently an alternative set of characters, introduced by the words "or if," will be found in the second paragraph of the pair (as on p. 101). These alternative characters generally refer to the variety described in the first paragraph that immediately follows.

---

[a] In a paper published in the Annals of the New York Academy of Science, 9, p. 8 (1895), a key of this style was first used by Mr. Cook. See also Proc. U. S. Nat. Mus., 18, p. 82 (1895).

It is believed that by including in the key the complete description of each variety, the identification can be made with more confidence than if only the characters necessary for "keying out" the varieties were given. While the construction of a key of this type presents difficulties that are not encountered in making the ordinary dichotomous key, it is believed that the user, after a little practice, will find it more serviceable. He will have the satisfaction, as it were, of touching ground at each step he takes.

After the name of each variety, at the end of the paragraph describing it, is given a reference to the page of the text on which will be found outlines of the seed and fruit.

1. Synopsis of the Groups.

* Flesh becoming quite dry and often hard, the white central portion thicker than the darker colored, softer outer portion (often twice as thick);[a] the fibrous lining of the central cavity clean and dry, bright white; giant cells in a more or less sharply defined zone lying between the white and the dark flesh, very small, generally not much longer than wide.
Dry dates.

** Skin becoming loose over much of the surface of the fruit, forming large, smooth, soft, mostly longitudinal blisters.
Smooth-skinned dry dates, p. 97.

** Skin closely adhering to most of the surface of the fruit, forming a network of narrow, hard, transverse as well as longitudinal wrinkles, with few or no large, soft blisters.
Wrinkled dry dates, pp. 97 to 99.

* Flesh not becoming dry and hard, the white central portion thinner than the dark colored, softer outer portion; the fibrous lining of the central cavity usually more or less soaked and darkened with sirupy juice; zone of giant cells not usually sharply defined (or at least not easily distinguishable in color) from the zone outside it, the cells usually variable in size and shape; skin becoming loosened over much of the surface of the fruit when ripe,[b] forming large, soft, generally longitudinal blisters, but otherwise smooth; or, if forming also a network of narrow transverse wrinkles, these few and soft .... Soft dates.

** Fruit spherical or nearly so, at least three-fourths as wide as long.
Round soft dates, p. 99.

---

[a] Exceptions are the varieties Bayjoo (p. 97), Thaby (p. 98) and Hamra (p. 98) in which the darker colored outer zone is much thicker than the white inner zone, at least in fruits that have been kept for some time. In other respects these are typical dry dates, having the clean, bright white lining of the central cavity and the skin covered with a network of hard, narrow wrinkles.

[b] The Khalt Mooashem variety (see p. 104) is an exception in having the skin closely adhering.

** Fruit not spherical or nearly so.

*** Fruit at least 3 mm. shorter than twice the width. Broad soft dates.

**** Flesh dark colored, very soft and sirupy, date not keeping its shape well when ripe. Sirupy broad soft dates, pp. 99–100.

**** Flesh rather firm, not sirupy, date keeping its shape well when ripe------------ Firm broad soft dates, pp. 100–101.

*** Fruit at least 3 mm. longer than twice the width. Narrow soft dates, pp. 101–102.

*** Fruit about twice as long as wide------ Intermediate soft dates.

**** Decidedly wider near the apex than at base. Obovate intermediate soft dates, p. 103.

**** Decidedly wider at the base than near the apex, tapering from near or below the middle to the apex. Ovate intermediate soft dates, pp. 103 to 105.

**** As wide or nearly as wide at the apex as at the base, either widest at or near the middle or else of about the same width throughout. Oblong intermediate soft dates, pp. 105–106.

2. Key to the Varieties.

Dry Dates.

SMOOTH-SKINNED DRY DATES.

Fruit only 25 mm. long (smallest of the Tunisian varieties), *about 17.5 mm. wide*, ovate or obovate, bright bay (IV, 5) when ripe, the skin ochraceous (V, 7) to cinnamon rufous (IV, 16); *flesh 2.5 mm. thick*, becoming hard and dry, more than one-half of it consisting of the white central portion; seed 18 mm. long, about 9 mm. wide, smooth, drab brown (III, 18), the ventral channel narrow, open, the germ pore generally considerably above the middle; giant cells in a sharply defined zone forming about one-half the thickness of the dark outer part of the flesh, very small, nearly all rounded, rarely more than 1½ times as long as wide, mostly spherical but some elliptical and pear-shaped, orange colored; *branches of the fruit clusters bright (lemon) yellow*-------------- *Angoo* (p. 74).

Fruit 35 to 40 mm. long, about one-half as wide, often slightly wider just above the middle than elsewhere, then narrowed to the truncate or blunt-pointed apex, dull bay (IV, 5) colored when ripe, the skin rufous (IV, 7) to hazel (IV, 12) colored; *flesh 3 to 4 mm. thick*, not becoming very dry; seed 21 to 25 mm. long, one-third to two-fifths as wide, rounded at both ends, Isabella brown (III, 23) in color, the ventral channel narrow, open, the germ pore above the middle; giant cells very uniform in size and shape, spherical or nearly so, rufous (IV, 7) colored; *branches of the fruit clusters light orange*------------------------------- *Kenta* (p. 73).

WRINKLED DRY DATES.

Fruit about 32.5 mm. long, three-fifths to two-thirds as wide, ovate in outline, dull orange yellow before maturity, purplish maroon (IV, 2) or bay (IV, 5) colored when ripe; flesh 3 mm. thick, the white central portion much thicker than the dark outer zone;[a] *seed* averaging 20 mm. long and *10 mm. wide*, Isabella brown (III, 23), the ventral channel wide, open, the *germ pore near the apex of the seed*, conspicuous; *giant cells* very small, *all rounded, nearly all spherical*, orange rufous (IV, 13) in color; branches of the fruit clusters pale orange-------------- *Bayjoo* (p. 83).

Fruit only about twice as long as wide.

---

[a] Although in fruits cut open several weeks after gathering the converse appears to be true, owing to the suffusion of the white zone with sirup from the dark portion.

Fruit mostly distinctly constricted a little above the base, 35 to 40 mm. long, oblong in outline, somewhat narrowed at the apex, dark maroon (IV, 2) when ripe; *flesh* 2 to 2.5 mm. thick, rather tough, *the white core much thicker than the dark-colored outer flesh;* seed averaging 22 mm. long, a little less than one-half as wide, widest near the apex, the ventral channel open, the germ pore below the middle; *giant cells* in a very sharply defined narrow zone, very small, *rounded,* mostly spherical or short elliptical, some pear-shaped, at least two-thirds as wide as long, cadmium orange (VI, 2) in color; branches of the fruit clusters bright orange. *Remta* (p. 83).

Fruit not constricted, or. if constricted, then the dark outer zone of flesh thicker than the white inner portion and about one-half of the giant cells angular.

Fruit sometimes indistinctly constricted a little above the base, 40 to 42.5 mm. long, *oblong,* somewhat narrowed at the apex, *bright madder brown* (IV, 3) *to orange rufous* (IV, 13) *when ripe;* flesh 2.5 to 3 mm. thick, rather tough, the dark-colored outer portion appearing to be much thicker than the (thin) white core;[a] seed averaging 24.5 mm. long and about 9 mm. wide, the ventral channel wide, open, the germ pore above the middle. giant cell zone indistinct, *the cells very small, about one-half angular and one-half rounded,* generally one-half to two-thirds as wide as long, elliptical or rectangular in outline, saffron (VI, 4) in color; branches of the fruit clusters rich orange ------------------------------ *Thaby* (p. 75).

Fruit not constricted, of some darker or duller color (*bay* (IV, 5) *to purplish maroon* (IV, 2)), *giant cells all rounded, or, if a considerable number angular, then the fruit distinctly ovate in outline and purplish maroon in color.*

Dark-colored (*outer*) *zone of the flesh thicker than the white inner portion; giant cells frequently angled* but the majority rounded, as often elliptical as spherical, *often twice* (but generally 1 to 1½ times) *as long as wide;* ocher yellow (V, 9) to ochraceous rufous (V, 5) in color; fruit ovate, tapering from or near the base to the rounded apex, 35 to 47.5 mm. long, rufous (IV, 7) or orange rufous (IV, 13) before maturity, bright purplish maroon (IV, 2) when ripe, the colors very handsome; flesh 2 to 6 mm. thick; seed two-thirds to four-fifths as long as the fruit, generally about two-fifths as wide as long, often with strongly developed, wing-like lateral ridges, the ventral channel generally open, the germ pore generally near the middle but sometimes almost at the base; branches of the fruit clusters cadmium orange (VI, 2) ------------------------- *Hamra* (p. 84).[b]

Dark-colored (*outer*) *zone of the flesh much thinner than the white inner portion; giant cells all rounded and generally spherical, rarely more than 1½ times as long as wide.*

Fruit ovate, tapering from the base to the rounded apex, 45 to 47½ mm. long, rather dull maroon purple when ripe, with a pronounced bloom; *flesh 4 to 5 mm. thick, firm and becoming rather dry;* seed very irregular in size but averaging 24 mm. long and 9.5 mm. wide, the ventral channel closed, the germ pore above the middle, sometimes near the apex; giant cells very small, ochraceous rufous (V, 5) in color; branches of the fruit clusters cadmium yellow (VI, 6) ----------------------------- *Horra* (p. 72).

Fruit not ovate, not tapering to the apex from below the middle, elliptical in outline, somewhat narrowed at both ends; flesh not exceeding 3.5 mm. thick.

Skin, where loose, between deep chrome (VI, 9) *and saffron* (VI, 4); *giant cells* ferruginous (IV, 10) in color, *forming a very sharply defined zone separated from the skin by a thicker layer of soft, dull-colored flesh;* fruit 35 to 38 mm. long, sometimes slightly obovate, but generally widest at or below the middle, dull orange just before maturity, dull bay (IV, 5) when ripe; flesh 2.5 to 5 mm. thick, becoming hard and dry; seed about two-thirds as long as the fruit, one-third to two-fifths as wide as long, broad and rounded at both ends, between russet (III, 16) and wood brown (III, 19), the ventral channel open; branches of the fruit clusters orange buff (VI, 22)____________________________ *Kenteeshy*[a] (p. 84).

---

[a] In this respect Thaby appears to be exceptional among the dry dates, but owing to the fact that, in fruits that have been kept for some time, sirup from the dark, soft outer zone suffuses the white, firm inner portion of the flesh (as noted in the footnotes on pp. 96 and 97), this character should not be given too much importance.

[b] Description supplemented by material from palms in the Tempe, Ariz., date garden which were obtained at Biskra, Algeria.

Skin, where loose, russet (III, 16); *giant-cell zone less sharply defined, with groups of these cells extending through the outer layer of flesh nearly to the skin.*

Ripe fruit dull purplish maroon (IV, 2), with considerable bloom, *35 to 40 mm. long*, often somewhat curved; flesh 2.5 to 4 mm. thick; seed about two-thirds as long as the fruit, generally one-third as wide as long, the ventral channel open; *giant cells wax yellow* (VI, 7); branches of the fruit clusters orange colored_________________________________ *Lemsy* (p. 75).

Ripe fruit dull bay (IV, 5) (dull Indian purple (VIII, 6) toward base), with considerable bloom, *32.5 to 35 mm. long;* flesh 2 to 3 mm. thick; seed about seven-tenths as long as the fruit, one-third to two-fifths as wide as long, the ventral channel open; *giant cells tawny* (V, 1) *brown;* branches of the fruit clusters pale orange________________________ *Halooa Bayda*[b] (p. 76).

SOFT DATES.

ROUND SOFT DATES.

Fruit 35 to 45 mm. in greatest diameter, mostly longer than wide, spherical or nearly so, *keeping its shape well when preserved, color before maturity dull orange brown, between maroon* (IV, 2) *and prune purple* (VIII, 1) *when ripe;* skin, where loose, tawny (V, 1); *flesh firm*, 8 to 10 mm. thick; *seed* very thick, six-tenths to seven-tenths as long as the fruit, about three-fifths as wide as long, *conspicuously roughened with longitudinal and transverse furrows*, the ventral channel closed, the germ pore not distinguishable; giant cells mostly spherical or quadrangular with rounded angles, rarely more than one and one-half times as long as wide, ferruginous (IV, 10) in color______________________ *Tronja* (p. 67).

Fruit 25 to 35 mm. in greatest diameter, usually somewhat wider than long, usually widest above the middle, often slightly depressed at the apex, *not keeping its shape well when preserved, deep chrome yellow* (VI, 8) *before maturity, very dark brown purple* (*almost black*) *when ripe; flesh very soft*, 6 to 10 mm. thick, very dark colored; *seed* two-thirds to four-fifths as long as the fruit, one-half to two-thirds as wide as long, mummy brown (III, 10) to russet (III, 16) color, *smooth*, the ventral channel nearly closed except near the apex; giant cells very variable in size and shape, spherical, elliptical or irregularly triangular or quadrangular with rounded angles, mostly one to one and one-half (rarely more than 2) times as long as wide, burnt umber (III, 8) colored; branches of the fruit clusters deep orange________________________ *Tantaboosht*[c] (p. 85).

BROAD SOFT DATES.

Sirupy Broad Soft Dates.

Fruit 32.5 to 35 mm. long, about three-fourths as wide, *very broad ovate, widest at the base and narrowed thence to the broad rounded apex, bright bay* (IV, 5) *colored* with a pronounced bloom *when ripe;* flesh very soft, about 3 mm. thick, translucent; seed wood brown (III, 19), one-half to two-thirds as long as the fruit, about one-half as wide as long, rounded at both ends, the ventral channel open throughout its length, the germ pore a little above the middle; giant cells mostly spherical, some short elliptical, a few angular, orange rufous (IV, 13) in color; branches of the fruit clusters light orange------------------------*Mokh Begry* (p. 76).

---

[a] Description supplemented by fruit from the garden at Tempe, Ariz., from a palm originally from Biskra, Algeria.

[b] The fruits of young palms labeled *Halooa* in the Tempe garden, originally from Biskra, Algeria, differ from the above description in several particulars and probably belong to another variety. It should be noted that in Tunis the word Halooa (sweetmeat) occurs as a prefix in the names of several very different varieties of dates. Thus, Halooa Ch'eb, Halooa Teboolboo, etc.

[c] Description supplemented from the fruit of 3 palms in the Tempe, Ariz., date garden.

Fruit, *wider at or above the middle than at the base, very dark brown or black when ripe.*

Fruit ovate, rather abruptly narrowed near the somewhat pointed apex, 40 to 42.5 mm. long, from a little less to a little more than one-half as wide; bright orange before maturity, *dark chestnut* (IV, 9) *with a tinge of maroon* (IV, 2) *when ripe;* flesh about 4 mm. thick; seed 20 to 25 mm. long, one-third to two-fifths as wide, burnt umber color (III, 8), the ventral channel open, the germ pore above the middle; giant cells nearly all rounded, either spherical or short elliptical, one and one-half to two times as long as wide, tawny (V, 1) colored; branches of the fruit clusters orange---------------------------------------*Baydh Hamman* (p. 77).

Fruit oblong or somewhat obovate, rounded at the broad apex, black or nearly so when ripe.

Fruit oblong or oblong ovate, 35 to 40 mm. long, generally more than one-half to two-thirds as wide, *bright orange before maturity, very dark brown (almost black) when ripe,* skin where loose raw umber (III, 14) colored; flesh 3 mm. thick; seed about one-half as long as the fruit, two-fifths to one-half as wide as long, *light brown (between Isabella* (III, 23) *and fawn* (III, 22) *color), the ventral channel open nearly or quite throughout its length, the germ pore considerably above the middle, very distinct; giant cells mostly angular* (quadrangular) but many spherical, ferruginous (IV, 10) in color----------------------*Tozer Zaid Safra* (p. 85).

Fruit generally oblong obovate, 37.5 to 42.5 mm. long, three-fifths to two-thirds as wide, *dark maroon* (IV, 2) *before maturity, black when ripe;* flesh about 4 mm. thick; seed about two-fifths as long as the fruit, two-fifths as wide as long, *burnt umber color* (III, 8) *the ventral channel almost completely closed, the dorsal circle at the middle, not very distinct; giant cells nearly all rounded,* mostly spherical, ferruginous (IV, 10) in color---------------------------------------*Tozer Zaid Khala* (p. 85).

Firm Broad Soft Dates.

Flesh thin (not exceeding 2.5 mm. in thickness), becoming very firm and dry, more than half of it consisting of a white fibrous core, fruit 25 mm. long. Angoo.[a]

Flesh thick (at least 4 mm. in thickest part), not becoming very dry, the white fibrous core forming much less than half of its thickness, fruit at least 32.5 mm. long.

Skin loosening in a network of narrow wrinkles as well as large soft blisters, orange rufous (IV, 13) *where loose; fruit* 35 to 37.5 mm. long, ovate or oblong ovate in outline, *widest at or below the middle,* purplish maroon (IV, 2) or bay colored (IV, 5) when ripe; flesh 4 to 5 mm. thick, firm yet tender; seed averaging 22 mm. long and 9 mm. wide, russet (III, 16) colored, the ventral channel open; giant cells in a well-defined zone, very small, irregularly quadrangular with rounded angles, to nearly elliptical or spherical in outline, wax yellow (VI, 7) to orange (VI, 3) in color; branches of the fruit clusters deep orange--------*Kseba* (p. 77).

Skin loosening in large soft blisters but not developing a network of narrow wrinkles.

Fruit about 37.5 mm. long, 22 to 26 mm. wide, *ovate (widest near the base), the surface dull,* orange colored before maturity, between maroon (IV, 2) and prune purple (VIII, 1) when ripe; skin where loose ochraceous (V, 7) to russet (III, 16); flesh 3 to 4 mm. thick, the central white fibrous core forming nearly one-half the total thickness; seed 18 or 19 mm. long, 9 or 10 mm. wide, narrowed at both ends, the ventral channel frequently closed, the germ pore a little above the middle; giant cells mostly about as wide as long and angular (irregularly quadrangular, pentagonal, etc., with rounded angles), orange rufous (IV, 13) in color; branches of the fruit clusters light orange ---------------------------------- *Doonga* (p. 78).

---

[a] This is properly a dry date and is described on p. 97; but on account of its smooth, blistered rather than wrinkled skin it might be sought in this part of the key.

Fruit obovate or obovate oblong (widest at or above the middle), its surface shining, at least 40 mm. long or, if shorter, the seed with more or less conspicuous wing-like lateral ridges.

Fruit 32.5 to 37.5 mm. long, about two-thirds as wide, bright bay (IV, 5) colored, the skin where loose tawny ochraceous (V, 4); flesh 4 mm. thick, light brown; *seed with more or less conspicuous lateral wing-like ridges,* two-thirds to three-fourths as long as the fruit, generally two-fifths as wide as long, broad at both ends, the ventral channel frequently closed; giant cells mostly spherical or very short elliptical, saffron yellow (VI, 4) -- *Besser Haloo* (p. 78).

Fruit 40 mm. or longer, the seed without wing-like ridges (although sometimes roughened).

Fruit somewhat fiddle-shaped, widest above the middle but often somewhat narrowed at the extreme apex, *constricted near the middle,* 40 to 45 mm. long, 22.5 to 25 mm. wide, greenish yellow before maturity, between maroon (IV, 2) and prune purple (VIII, 1) when ripe; skin where loose ochraceous (V, 7); flesh 5 mm. thick, firm but tender; seed about three-fifths as long as the fruit, about one-third as wide as long, the ventral channel open, germ pore small and inconspicuous; *giant cells all rounded, decidedly longer than wide, ferruginous* (IV, 10) *in color;* branches of the fruit clusters orange ------------------------------------ *Boo Fagoos* (p. 67).

Fruit not fiddle-shaped nor constricted near the middle, giant cells angular, about as wide as long, saffron yellow (VI, 4) *to light orange* (VI, 3) *in color.*

Fruit 45 to 50 mm. long, slightly more than one-half to three-fifths as wide, *conspicuously wider above than below the middle, then narrowed to the blunt apex, bright orange before maturity, bright purplish maroon* (IV, 2) *when ripe;* skin loose over much of the surface, ochraceous (V, 7) to ochraceous rufous (V, 5); flesh 6 to 7 mm. thick; seed 24 to 27 mm. long, about two-fifths as wide, cinnamon brown (III, 20), the ventral channel open; *branches of the fruit clusters deep orange.*
Boo Affar (p. 66).

Fruit 40 to 60 mm. long, one-half to two-thirds as wide, *only slightly wider above than below the middle, broad and rounded at apex, dull orange before maturity, light bay* (IV, 5) *or hazel* (IV, 12) *colored when ripe,* the skin in large part loose and conspicuously blistered in the ripe fruit, orange (VI, 3) to ochraceous (V, 7) in color; flesh 5 to 6 mm. thick; seed about one-half as long as the fruit, less than one-half as wide as long, cinnamon rufous (IV, 16) in color, its surface roughened here and there with irregular ridges and furrows, the ventral channel frequently closed, the germ pore above the middle; giant cells very diverse in shape and size, irregularly quadrangular, pear or cigar shaped, saffron (VI, 4) to orange (VI, 3) in color; *branches of the fruit clusters light orange.*
Areshty (p. 71).

NARROW SOFT DATES.

Skin conspicuously marked with short, linear scars, fruit 47.5 to 52.5 mm. long, 17.5 to 20 mm. wide, oblong, tapering slightly from base to apex, not curved or very slightly so, *bright bay* (IV, 5) *when ripe,* the skin where loose ochraceous (V, 7) colored; flesh 3 to 4 mm. thick, soft, translucent; seed 30 mm. long, about one-third as wide, the ventral channel sometimes closed, the germ pore considerably above the middle, very distinct; *giant cells* mostly 2 to 3 times as long as wide, *mostly angular or pointed,* raw sienna (V, 2) colored -- *Tafazween* (p. 68).

Skin not marked with linear scars, giant cells rounded, or, if angular, the fruit prune purple (VIII, 1) *when ripe.*

Fruit 50 to 62.5 mm. long, 22.5 to 27.5 mm. wide, oblong, somewhat pointed at apex, usually curved, greenish yellow before maturity, prune purple (VIII, 1) with considerable bloom when ripe; skin where loose russet

(III, 16), surface dull; *flesh 6 to 7 mm. thick*, rather tough; seed 25 to 30 mm. long, about one-third as wide, the ventral channel very open; *giant cells variable in shape, many angular or sharp pointed*, others spherical or elliptical, 1 to 3 times (the great majority 1 to 1½ times) as long as wide, ferruginous (IV, 10) in color; branches of the fruit clusters bright orange............................*Sayba Boo Dra* (p. 86).

Fruit not exceeding 52.5 mm. long, giant cells with rounded outlines, none or very few angular.

Fruit not curved, 50 to 52.5 mm. long, about 20 mm. wide, oblong, somewhat pointed, yellowish to reddish orange before maturity, *deep maroon* (IV, 2) *to prune purple* (VIII, 1) *when ripe*, the skin russet (III, 16) where loose, shiny; flesh 5 to 6 mm. thick, soft; seed slender, 23 to 26 mm. long, less than one-third as wide, between russet (III, 16) and burnt umber (III, 8) colored, the ventral channel narrow, open; giant cells mostly elliptical, many spherical, a few rod-shaped (more than twice as long as wide) none angular, deep ferruginous (IV, 10) in color; branches of the fruit clusters orange.......................*Okht Fteemy* (p. 79).

Fruit more or less curved or, if straight, bay (IV, 5) *to light maroon* (IV, 2) *in color.*

Fruit straight or nearly so, 40 to 50 mm. long, two-fifths to nearly one-half as wide, oblong or somewhat obovate in outline, *not keeping its shape well when ripe*, conspicuously mucronate, orange before maturity, bay (IV, 5) colored when ripe, skin where loose russet (III, 16), shiny; *flesh 4 to 8 mm. thick, very soft and sirupy;* seed 25 to 28 mm. long, two-sevenths to one-third as wide, broad and rounded at both ends, ventral channel closed near the middle or open throughout; giant cells usually spherical but often short elliptical, never angular, rarely more than one and one-half times as long as wide, orange (VI, 3) to russet (III, 16) colored; branches of the fruit clusters bright orange.............*Rhars* [a] (p. 79).

Fruit more or less curved, keeping its shape well when ripe, flesh not more than 4 mm. thick, rather firm.

Skin mostly loose, light yellow (between saffron (VI, 4) *and maize* (VI, 21)), *blistering conspicuously* in ripe fruit; fruit about 50 mm. long, less than two-fifths as wide, oblong, often somewhat larger near the apex than elsewhere, between bay (IV, 5) and maroon (IV, 2) when ripe, its surface shiny; flesh 2.5 to 3.5 mm. thick, rather soft; seed 27 to 28 mm. long, about one-third as wide, generally somewhat curved, between fawn (III, 22) and cinnamon (III, 20) colored, the ventral channel open, the germ pore considerably above the middle, conspicuous; giant cells spherical to short elliptical (the great majority less than twice as long as wide), none angular, deep ferruginous (IV, 10) in color; branches of the fruit clusters orange...........................*Kharooby* (p. 86).

Skin not conspicuously blistered, russet (III, 16) *or hazel* (IV, 12) *colored.*

Fruit 45 mm. long, 20 mm. wide, oblong, tapering slightly to the apex, *bay* (IV, 5) *to light maroon* (IV, 2) *in color when ripe*, rather shiny; *flesh 3.5 to 4 mm. thick*, rather tough; seed 27 to 30 mm. long, about one-third as wide, russet (III, 16), its surface roughened with fine wrinkles, the ventral channel open, the germ pore below the middle; *giant cells spherical to rod-shaped, many of them 3 times as long as wide, none angular, raw sienna* (V, 2) *in color;* branches of the fruit clusters orange...*Lagoo* (p. 80).

Fruit 45 to 50 mm. long, about two-fifths as wide, oblong, often strongly curved, *very dark prune purple* (VIII, 1) with a conspicuous bloom *when ripe;* skin rather tough, *not shiny; flesh 2 mm. thick;* seed 25 to 30 mm. long, about one-third as wide, russet (III, 16), often curved, the ventral channel narrow, open; *giant cells sometimes angular or pointed, the majority spherical, few more than one and one-half times as long as wide, orange ochraceous* (V, 3) *in color;* branches of the fruit clusters deep orange. *Gasby* (p. 87).

---

[a] Description supplemented from fruit from Tempe, Ariz., garden, borne by 2 palms originally from Biskra, Algeria.

INTERMEDIATE SOFT DATES.

Obovate Intermediate Soft Dates.

Fruit 42.5 to 45 mm. long, square at base, rounded at apex, bright orange before maturity, *becoming very dark (almost black) brown purple when ripe;* flesh about 3 mm. thick, very dark colored and very soft, fruit keeping its shape poorly when ripe; seed 20 to 24 mm. long, two-fifths to one-half as wide, rounded at both ends, the ventral channel rather wide, open; *giant cells extremely variable in shape and size, mostly sharp angled and even pointed, triangular or quadrangular in outline,* orange rufous (IV, 13) in color; branches of the fruit clusters deep orange. *Bent Segny* (p. 87).

Fruit maroon (IV, 2) *or bay* (IV, 5) *when ripe; giant cells fairly uniform in shape and size, not pointed or triangular.*

Fruit 40 to 42.5 mm. long, tapering slightly at both ends, extremely soft, *not keeping its shape when preserved,* bright bay (IV, 5) when ripe, skin where loose saffron colored (VI, 4); flesh about 3 mm. thick, translucent, light colored; seed 24 to 26 mm. long, about one-third as wide, the ventral channel open; *giant cells all rounded,* mostly spherical but a few elliptical, none more than twice as long as wide, mostly much smaller than in Bent Segny, orange rufous (IV, 13) in color___*Deglet Hassen* (p. 92).

Fruit not exceeding 40 mm. long, moderately soft, keeping its shape fairly well when preserved; giant cells many of them angular.

Fruit very dark colored (between prune purple (VIII, 1) *and brown) when ripe,* 30 to 38 mm. long, generally obovate or obovate oblong, square at base, rounded at apex; skin where loose burnt umber (III, 8) color; flesh 2 to 3 mm. thick, very soft and dark colored; fibrous lining of the central cavity well developed; seed about two-thirds as long as the fruit, about two-fifths as wide as long, blunt at both ends, mars brown (III, 13) in color, the ventral channel open, the germ pore very indistinct; *giant cells chiefly spherical or short elliptical* but many quadrangular with rounded angles, *few of them more than one and one-half times as long as wide,* tawny (V, 1) in color; branches of the fruit clusters orange (VI, 3)________________________*Ammary*[a] (p. 88).

Fruit bay (IV, 5) *or maroon* (IV, 2) *when ripe; giant cells all or nearly all angular, mostly not longer than wide, almost never more than one and one-half times as long as wide.*

Fruit about 40 mm. long; seed averaging 25 mm. long, about one-third as wide, *the ventral channel wide, open, the germ pore near the base;* flesh about 3 mm. thick; *giant cells mostly angular but many spherical,* the great majority not longer than wide ($\frac{1}{3}$ to $\frac{1}{2}$ as large as in Deglet Hassen), orange ochraceous (V, 3) in color; branches of the fruit clusters bright *orange*________________________ *Goondy* (p. 88).

Fruit 35 to 37.5 mm. long; flesh about 3 mm. thick; *seed averaging 20 mm. long,* about two-fifths as wide, *the ventral channel narrow but open; giant cells all more or less angular,* (about twice as large as in Goondy), ochraceous (V, 7) in color; branches of the fruit clusters orange_____ *Zekry* (p. 81).

Ovate Intermediate Soft Dates.

*Firm white central portion of the flesh at least twice as thick as the soft, dark-colored outer portion*________________________*Kenta.*[b]

Firm white central portion of the flesh not nearly so thick as the soft, dark-colored outer portion.

White fibrous lining of the central cavity little developed; fruit 35 to 50 mm. long, narrowed from about the middle to the rounded apex and often also to the base, orange rufous (IV, 13) before maturity, maroon (IV, 2) when ripe, its skin ochraceous (V, 7) colored where loose, shiny; flesh soft, 4 to 6 mm. thick; *seed* a little more than half as long as the fruit, *generally conspicuously pointed at the apex and often narrowed to the base, very smooth, chestnut* (IV, 9) *colored;* the ventral channel more or less closed; giant cells mostly rounded (a few with rounded angles), either spherical or short elliptical (1 to 2 times as long as wide), rufous (IV, 7) colored, branches of the fruit clusters maize (VI, 21) yellow. *Deglet Noor* (p. 63).

---

[a] Description drawn up from material from Tempe, Ariz., garden, from a palm originally from Ourlana, Algeria.

[b] This variety (as well as the Angoo, p. 97) belongs evidently to the dry date class, and is described on p. 97; but, on account of its smooth, very loose skin (narrow transverse wrinkles few or none), it is likely to be sought in this part of the key.

White fibrous lining strongly developed throughout the length of the central cavity; seed generally rounded at both ends, rough, light colored (cinnamon (III, 20) *to Isabella* (III, 23) *brown*).

Ripe fruit dark prune purple, its skin adhering closely to the flesh, (*very little blistered or wrinkled*), *conspicuously marked with transverse and longitudinal linear scars;* fruit 40 to 45 mm. long, narrowed from about the middle to the rounded apex, keeping its shape perfectly when ripe; flesh about 4 mm. thick, firm but tender; seed 22 to 23 mm. long, nearly one-half as wide, widest near the middle, rounded at the ends, the ventral channel closed; giant cells very small, the majority angular (generally somewhat regularly quadrangular), but many spherical or pear-shaped, rarely more than one and one-half times as long as wide, orange rufous (IV, 13) colored; branches of the fruit clusters bright orange. *Khalt Mooashem* (p. 81).

Ripe fruit not darker in color than purplish maroon (IV, 2), *much of the skin blistered, not scarred.*

Branches of the fruit clusters maize yellow (VI, 21); *fruit 40 to 42.5 mm. long,* narrowed from about the middle to the rounded apex, *between maroon* (IV, 2) *and prune purple* (VIII, 1) *when ripe,* with considerable bloom; skin where loose tawny ochraceous (V, 4), somewhat shiny; flesh about 4 mm. thick; seed about two-fifths as long as the fruit, about one-third as wide as long, cinnamon brown (III, 20), the ventral channel open, the germ pore above the middle; *giant cells* very uniform in shape and size, *nearly all rounded and spherical,* ferruginous (IV, 10) *in color*__________________ *Khalt Deglaowia* (p. 82).

Branches of the fruit clusters orange (VI, 3), *fruit 45 to 50 mm. long or, if shorter, the ripe fruit bay colored* (IV, 5) *and the giant cells mostly sharp-angled.*

Fruit 40 mm. long, narrowed from near the base to the rounded apex, dull orange before maturity, *bay colored* (IV, 5) *when ripe,* skin where loose tawny olive (III, 17), somewhat shiny; *flesh about 3 mm. thick,* rather tough; seed 23 to 25 mm. long, about one-third as wide, the ventral channel open; *giant cells* very diverse in shape and size, *the great majority sharp-angled* (very few spherical), and irregularly triangular or quadrangular in outline, sometimes irregularly club-shaped or cigar-shaped, often sharp-pointed or even aristate, more than half of them 2 to 3 times as long as wide, orange (VI, 3) to orange rufous (IV, 13) in color__________________ *Karooy* (p. 89).

Fruit 45 to 50 mm. long; giant cells all rounded or, if sharp-angled, the color of the fruit dark (*between maroon* (IV, 2) *and prune purple* (VIII, 1) *and the flesh 4 to 6 mm. thick.*

Flesh only 3 mm. thick, translucent, soft, *sugar not crystallizing on the cut surface; fruit 50 mm. long,* tapering from at or near the base to the somewhat pointed apex, *light orange before maturity, bright bay* (IV, 5) *when ripe;* skin where loose ochraceous (V, 7), shiny; seed about one-half as long as the fruit, about two-fifths as wide as long, deeply furrowed at base, the ventral channel open; giant cells all rounded (or a few very indistinctly angled), the majority elliptical (1½ to 2 times as long as wide), a few spherical, orange rufous (IV, 13), of nearly the same size and color as in the Deglet Noor (see above)__*Sclatny* (p. 93).

Flesh 4 to 6 mm. thick, sugar crystallizing conspicuously on the cut surface; fruit 45 to 50 mm. long, dull orange red before maturity, dark maroon (IV, 2) *to prune purple* (VIII, 1) *when ripe.*

Fruit narrowed from at or near the base to the somewhat pointed apex, skin where loose tawny (V, 1); seed 25 to 26 mm. long, about one-third as wide, more or less truncate at apex, the ventral channel open or partly closed; *giant cells very small* (resembling those of Deglet Noor and Selatny), *quite uniform in size and shape, all rounded,* spherical or short elliptical, *rarely more than one and one-half times as long as wide, rufous* (IV, 7) *in color*______________________*Khalt Horraowia* (p. 82).

Fruit not conspicuously narrowed until from about the middle, broad at apex, skin where loose ochraceous (V, 7), seed 24 to 25 mm. long, about two-fifths as wide, rounded at apex, the ventral channel open or partly closed; *giant cells 3 to 4 times as large as in the preceding, extremely diverse in size and shape, all angled* (generally sharply so), irregularly triangular or quadrangular or angular rod, club, or pear shaped, *often three to four times as long as wide, between saffron* (VI, 4) *and orange* (VI, 3) *in color*____________________________*Khalt Menakhry*[a] (p. 93).

Oblong Intermediate Soft Dates.

Fruit nearly black when ripe, very soft, not keeping its shape well, 35 to 40 mm. long; *giant cells mostly angular*_________*Tozer Zaid Safra*[b] (p. 85).

Fruit not darker than chestnut (IV, 9) *or maroon* (IV, 2) *when ripe, or, if black, the giant cells all rounded, none angular.*

Fruit black when ripe, very soft, not keeping its shape well, 40 to 45 mm. long; seed about three-fifths as long as the fruit, about one-third as wide as long, between mummy brown (III, 10) and russet (III, 16) in color, the ventral channel open or partly closed, the germ pore above the middle; *giant cells all rounded,* spherical or short elliptical, not more than one and one-half times as long as wide, orange (VI, 3) colored.
Tenaseen[c].

Fruit brown, bay (IV, 5), *or maroon* (IV, 2) *when ripe.*

*Fruit conspicuously wider near the middle than elsewhere and rapidly diminishing in width from that point to the narrow base and apex; seed generally tapering from near the apex to a rather sharp point*_______*Deglet Noor.*[d]

Fruit only moderately wider near the middle than elsewhere and gradually diminishing from that point to the base and apex, or else of about the same width throughout almost its entire length; seed more or less rounded and abruptly tipped (mucronate) at apex, not taper pointed.

Fruit when ripe light hazel (IV, 12) *colored without any tinge of purple,* the skin where loose saffron-yellow (VI, 4), shiny, 47.5 to 50 mm. long, somewhat blunt pointed at the apex, *not keeping its shape well; flesh* about 5 mm. thick, *very soft and sirupy,* with almost no white fibrous lining to the central cavity; seed 23 to 25 mm. long, a little more than one-third as wide, russet (III, 16) to chestnut (IV, 9) colored, the ventral channel open, the germ pore below the middle; *giant cells* quite uniform in size, *mostly rounded* (spherical, short elliptical, or pear-shaped), some quadrangular with rounded angles, none more than one and one-half times as long as wide, orange rufous (IV, 13) to ferruginous (IV, 10) in color.
Deglet Hamidatoo (p. 92).

Fruit when ripe darker colored, bay (IV, 5), *maroon* (IV, 2), *or chestnut* (IV, 9), *with a purple tinge or, if hazel* (IV, 12) *colored and without purple tinge, then of rather firm consistency, keeping its shape well when preserved and with the giant cells mostly angular* (*Areshty*).

---

[a] These four "Khalts" (Mooashem, Deglaowia, Horraowia, and Menakhry) have the skin more or less conspicuously transversely wrinkled as well as blistered, and the flesh, although tender, of quite firm consistency, characters belonging rather to the dry than the soft dates (see p. 96), and they appear to be somewhat related to the Horra variety (see p. 98); but on account of their thick sugary flesh and rich flavor, it seems proper to class them among the soft dates.

[b] The fruit of this variety is usually considerably less than twice as long as wide (see p. 100).

[c] This variety is common in the oases of eastern Algeria. A young palm in the garden at Tempe, Ariz., originally from Ourlana, Algeria, has much shorter, obovate fruit and although labeled "Tenaseen" it is certainly not identical with the above-described fruit, which was obtained in the Oued Souf. The latter is in all probability the true Tenaseen.

[d] This variety has the fruit generally decidedly larger near the base than near the apex and is therefore classed with the ovate intermediate soft dates. The form described on this page is the exception, that on page 104 is the rule.

Fruit when ripe chestnut colored (IV, 9) *with a very slight purple tinge*, the skin where loose tawny olive (III, 17) or ochraceous (V, 7), shiny, *the fruit* bright orange before maturity, nearly 50 mm. long, somewhat pointed and *conspicuously one-sided at apex*, not keeping its shape well when ripe; *flesh* about 4.5 mm. thick, *extremely soft and sirupy;* seed 23 to 24 mm. long, about two-fifths as wide, chestnut (IV, 9) colored; the ventral channel more or less closed, giant cells very diverse in size and shape, all angled (often sharply so), generally considerably longer than wide, triangular, quadrangular, or somewhat pear-shaped, the outlines often very irregular, ferruginous (IV, 10) in color --- *Iteema* (p. 89).

Fruit when ripe bay (IV, 5) *or maroon* (IV, 2) *to prune purple* (VIII, 1) (*varying to hazel* (IV, 12) *in Areshty*), *not or not conspicuously one sided at apex.*

White fibrous lining to the central cavity almost none, flesh only about 2 mm. thick, all soft and dark colored when ripe; fruit 45 mm. long, oblong, narrowed slightly at both ends, keeping its shape only fairly well when ripe, bright orange yellow before maturity, maroon (IV, 2) with slight purple tinge when ripe, *skin where loose saffron* (VI, 4) *to orange* (VI, 3), shiny; seed about three-fifths as long as the fruit and about one-third as wide as long, the ventral channel open or closed; giant cells never more and usually less than twice as long as wide, quite variable in form, nearly all angular, in outline triangular, quadrangular, or somewhat pear-shaped; color orange rufous (IV, 13) to ferruginous (IV, 10) --- *Chedakh* (p. 92).

White fibrous lining to the central cavity well developed, flesh at least 3 mm. thick, skin where loose ochraceous (V, 7) *to russet* (III, 16), *rarely orange* (VI, 3).

Flesh soft and sirupy, 4 mm. thick; fruit keeping its shape only fairly well when ripe, 42.5 to 47.5 mm. long, slightly narrowed at both ends, reddish orange before maturity, between dark maroon (IV, 2) and prune purple (VIII, 1) with a conspicuous bloom when ripe, its surface shiny; seed between one-half and three-fifths as long as the fruit, usually slightly less than one-third as wide as long, widest below the middle or about equally wide throughout, the ventral channel open; *giant cells nearly all angular*, similar to those of the preceding (Chedakh); branches of the fruit clusters deep orange --------------------------- *Fteemy* (p. 69).

Flesh of firm consistency, fruit keeping its shape well when ripe, broad at base or, if somewhat narrowed at base, the fruit only 40 mm. long, then the flesh only 3 mm. thick and the giant cells all rounded or nearly so.

Fruit 40 mm. long, generally slightly narrowed at both ends, bright maroon when ripe, with considerable bloom; *flesh 3 mm. thick, not very sugary; seed smooth*, 25 mm. long, about two-fifths as wide, widest above the middle, the ventral channel open, the germ pore above the middle; giant cells very uniform in size and shape, all rounded, spherical or nearly so, orange (VI, 3) in color ------------------------ *Khalt Hameed* (p. 89).

Fruit 40 to 60 mm. long, broad at base, flesh 4 to 6 mm. thick, very sugary; seed rough.

Fruit 47.5 to 55 mm. long, oblong or oblong ovate, broad and rounded at base and apex, keeping its shape well when ripe, dull orange yellow before maturity, *between maroon* (IV, 2) *and chestnut* (IV, 9) *or between chestnut and hazel* (IV, 12) *colored* with a purplish bloom *when ripe;* flesh 4 to 6 mm. thick, the white fibrous lining to the central cavity well-developed; *seed* 23 to 25 mm. long, two-fifths to one-half as wide, russet (III,16) to chestnut (IV, 9) colored, *its surface uniformly roughened with small pits and fine wrinkles*, the ventral channel frequently closed, the germ pore usually distinct, always above the middle of the seed; *giant cells quite uniform in size and shape, all rounded*, mostly spherical but some short-elliptical (1½ or nearly 2 times as long as wide), *rufous* (IV, 7) *colored; branches of the fruit clusters lemon yellow.*
Menakher (p. 61).

Fruit dull orange before maturity, light bay (IV, 5) *or light hazel* (IV, 12) *colored when ripe; seed roughened here and there with irregular ridges and furrows; giant cells very diverse in shape and size, nearly all angular, saffron* (VI, 4) *to orange* (VI, 3) *in color; branches of the fruit clusters light orange* ------------------------------ *Areshty*[a] (p. 71).

---

[a] The fruit of this variety is generally at least 4 mm. less than twice as long as wide, and it is therefore described more fully under Broad Soft Dates. (See p. 101.)

INDEX.

Page.
Algerian oases, climate compared with Tunis oases 22, 23, 24, 27, 28
Alkali soils 36–41
  composition of the alkali 37
  reclamation 36
  resistant varieties of date palm 66, 70, 72, 74, 78, 79, 84, 85
Ammary variety 87, 103
Angoo variety 74, 97
Areshty variety 70, 101
Arizona localities, climate compared with Tunis oases 22, 23, 24, 27, 28
Atmospheric humidity 26
Baydh Hammam variety 76, 100
Bayjoo variety 82, 97
Bent Segny variety 87, 103
Besser Haloo variety 78, 101
Boo Affar variety 58, 66, 101
Boo Fagoos variety 58, 67, 101
Calcium sulphate in soils 34, 38
Chedakh variety 92, 106
Classification of varieties by botanical characters 95–97
  by commercial value 57
Climate of Tunisian oases 21–28
  humidity 26–27
  precipitation 25, 27–28
  temperature 21–26
Climate of different years as affecting date crop 25, 26, 51, 52
Colors, terms used in describing 95
Cost of agricultural operations 45, 47, 53–54
Cultivation of soil 45
Culture of date palm 41–55
Date crop as affected by climate of different years 25, 26, 51, 52
Deglet Barca variety 90
  Caid variety 90
  Hamidatoo variety 92, 105
  Hassen variety 92, 103
  Noor variety 58, 63, 104
    alkali resistance 66
    botanical characters 63, 104
    climatic conditions necessary 64
    commercial importance 58, 63
    geographical distribution and abundance 64
    harvesting 52–54
    productiveness 65
    quality in Tunis as compared with Algeria 65
    quality of fruit from commercial standpoint 58, 63
    slow development of palms 65
    time of ripening 65
  Sennayga variety 90
Djerid. *See* Jerid.
Doonga variety 77, 101
Douz oasis 19
Drainage, chemical composition of drainage water 40
  description of system 33
  importance in reclaiming alkali soils 36

Page.

- Dry dates, characteristics 60, 96
  - value as vegetarian food 73
- El Hamma oasis (Gabes) 19
  - (Jerid) 17
- El Oudiane oasis 16
- Fertility of soils 35
- Folklore of date palm 14, 46
- Fruit clusters, removal from very young trees 50
  - straddling to prevent breaking of stalks 51
- Fteemy variety 57, 59, 68, 106
  - alkali resistance 70
  - botanical characters 68–69, 106
  - commercial importance 69, 70
  - geographical distribution and abundance 69
  - keeping quality 70
  - productiveness 70
  - rapid development of palms 69, 70
  - time of ripening 70
- Ftimi. *See* Fteemy.
- Gabes oasis 19–20
- Gafsa oasis 20–21
- Gardens, characteristics 13, 55
  - protection from sand 14
  - size and value 41–42
  - sunken 16, 19
- Gasb Haloo variety 90
- Gasby variety 87, 102
- Geography 11–21
- Germ pore of date seed 94
- Giant cells of date 95
- Goondy variety 88, 103
- Groups of varieties, synopsis 96–97
- Guern-el-Rhezal variety 90
- Gypsum content of soils 34, 38
- Haloona Bayda variety 75, 99
- Hamra variety 83, 98
- Harvesting dates 52–54
- Heat, total in Tunisian oases 24–26
- Horra variety 59, 71, 98
- Humidity, atmospheric 26–27
  - effect on ripening of dates 19
- Implements. *See* Tools.
- Importation of offshoots 10, 56
- Irrigation 28–33, 47–48
  - amount of water used 29, 47
  - chemical composition of water 30–31
  - frequency at different seasons 47–48
  - methods 33, 47
  - newly planted palms 47
  - relation to ripening of dates 48
  - saline or alkaline water used 40, 48
  - system of canals and dams 31–33
- Iteema variety 89, 106
- Jerid oasis 11–17
- Karooy variety 88, 104
- Kenta variety 59, 72, 97
- Kenteeshy variety 84, 99
- Key to the varieties 97–106
- Khadraya variety 90
- Khalt Boo Fagoos variety 91
  - Deglaowia variety 81, 104
  - Gama variety 91
  - Hameed variety 89, 106
  - Horraowia variety 82, 105
  - Keber variety 91
  - Kentaowia variety 91

Page
Khalt Menakhry variety 93, 105
  Mooashem variety 81, 104
Kharooby variety 86, 102
Kseba variety 77, 100
Labor 42–43
Lagoo variety 80, 102
Legends concerning the date palm 14, 46
Lemsy variety 75, 99
Male palms 50–51
Manuring 49–50
Measurements given in descriptions 94
Menakher variety 57, 60, 106
  botanical characters 60–61, 106
  commercial possibilities 57, 61, 62
  geographical distribution and rarity 57, 62
  introduction into United States 57, 58, 63
  keeping quality 61
  multiplication, rapid, possibility 58
  productiveness 62
  propagation, difficult 63
  quality of fruit 61, 62
  ripening, time 62
Mokh Begry variety 57, 76, 100
Names of varieties 56
Nefta oasis 15–16
Nefzaoua oases 17–19
Nomenclature of varieties 56
Oases, area covered and number of date palms 15–20
  description 13
  protection from sand 14, 18
Offshoots, importation, number 10
  packing for transportation 45
  prices paid 44
  production, how stimulated 43
  removal from parent tree 44–45
  size for transplanting 44
Okht Ammary variety 91
  Fteemy variety 79, 102
Packing dates for shipment 54
Planting 46–47
Pollination 50
  relation of irrigation 48
Population of oases 15, 42, 43
Precipitation 25, 27–28, 51–52
Preparing land for planting date palms 45
Preserving dates 54–55
Propagation 43–45
Rainfall. *See* Precipitation.
Reclamation. *See* Alkali.
Remta variety 83, 98
Rhars variety 80, 102
Ripening of dates 51–52
  climatic factors affecting 23–26
  hastening, suggestions 52
  relation of irrigation 48
Saline soils. *See* Alkali.
Salt. *See* Alkali.
Salton Basin, Cal., climate compared with Tunis oases 22, 24, 25, 27–28
Sand, protection of oases 14, 18
Sayba Boo Dra variety 86, 102
Sba Aroossa variety 91
Seacoast, date culture near 19, 20
Seedling date palms 43
Selatny variety 57, 93, 104
Shelter for young palms 47
Shipment of dates, factors affecting 15, 54

Page.

Soft dates, characteristics 60, 96

Soils of Tunisian oases 33–41
  alkali content 36–41
  fertility 35
  texture 33–35

Suckers. *See* Offshoots.

Sunken gardens 16, 19

Tafazaouine. *See* Tafazween.

Tafazween variety 58, 68, 101

Tantaboosht variety 84, 99

Temperature 21–26

Tenantry system 42–43

Tenaseen variety 89, 105

Thaby variety 74, 98

Tools used by natives 44–45

Topography. *See* Geography.

Towadant variety 91

Tozer oasis 16
  Zaid Khala variety 85, 100
    Safra variety 85, 100

Trimming off old leaves 50

Tronja variety 58, 66, 99

Troundja. *See* Tronja.

Varieties of the date palm 55–106
  classification by botanical characters 96–106
  geographical distribution 55
  grading as to quality of fruit, etc 57
  groups, synopsis 96–97
  importation, considerations governing 10
  key 97–106
  nomenclature followed 56
  number in Tunis 55–56

Watering. *See* Irrigation.

Water supply 18, 19, 28–31

Winds, dry, hot, effect upon fruit 51
  north, shelter from 16, 17
  sand-bearing, protection against 14, 18

Zekry variety 81, 103

Zrai variety 91

PLATES.

92

111

DESCRIPTION OF PLATES.

Plate I. Frontispiece. Harvesting Deglet Noor dates from tall trees at Tozer.

Plate II. Fig. 1.—An unirrigated tract of alkali land in the midst of Tozer oasis, with a growth of salt-loving samphire, or "pickle weed." Only water is needed to transform this spot into luxuriant date gardens, like those surrounding it. Fig. 2.—Working the soil of a date garden with the "messah," or short-handled hoe, preparatory to planting onions. Illustrates the frequent cultivation given well-cared-for date gardens; also (background), recently planted palms sheltered by tent-like coverings of date leaves.

Plate III. Date palm (Khalt Aly Meskeen variety) showing the "straddling" of a heavy bunch of fruit to prevent the breaking of the stalks. This is a common practice in the Tunis oases and saves much fruit that would otherwise be lost.

Plate IV. Fig. 1.—A Tronja palm with numerous offshoots (one as large as the main trunk) in unirrigated alkali land, showing the characteristic curving of the leaves. Fig. 2.—A typical male date palm, showing the characteristic heavy crown of foliage.

Plate V. Fig. 1.—Menakher palm at Nefta, said to be 20 years old. One of the offshoots shown was imported into the United States. Fig. 2.—Older Menakher palm at El Oudiane, with two large fruiting offshoots.

Plate VI. Fig. 1.—Deglet Noor palm, oasis of El Oudiane, showing the characteristic drooping of the long-stalked fruit clusters. Fig. 2.—Lagoo palm, showing horizontal or erect short-stalked fruit clusters. Fig. 3.—The town of Nefta, a community supported almost entirely by date culture.

Plate VII. Fig. 1.—Full-grown Fteemy palms in a hollow, oasis of El Oudiane. Fig. 2.—A plantation of 6-year-old date palms at the edge of Nefta oasis, in land that was formerly covered with an efflorescence of salts. The varieties represented are Fteemy, Okht Fteemy, and Deglet Noor (a Fteemy palm near the center in the foreground). The arrangement of the "lands" for irrigation and a young crop of alfalfa among the palms are shown.

Plate VIII. Dates, natural size. (1) Deglet Noor variety; (2) Menakher variety.

Plate IX. Dates, natural size. (1) Tronja variety; (2) Boo Affar variety.

Plate X. Dates, natural size. (1) Horra variety; (2) Kenta variety; (3) Fteemy variety; (4) Mokh Begry variety.

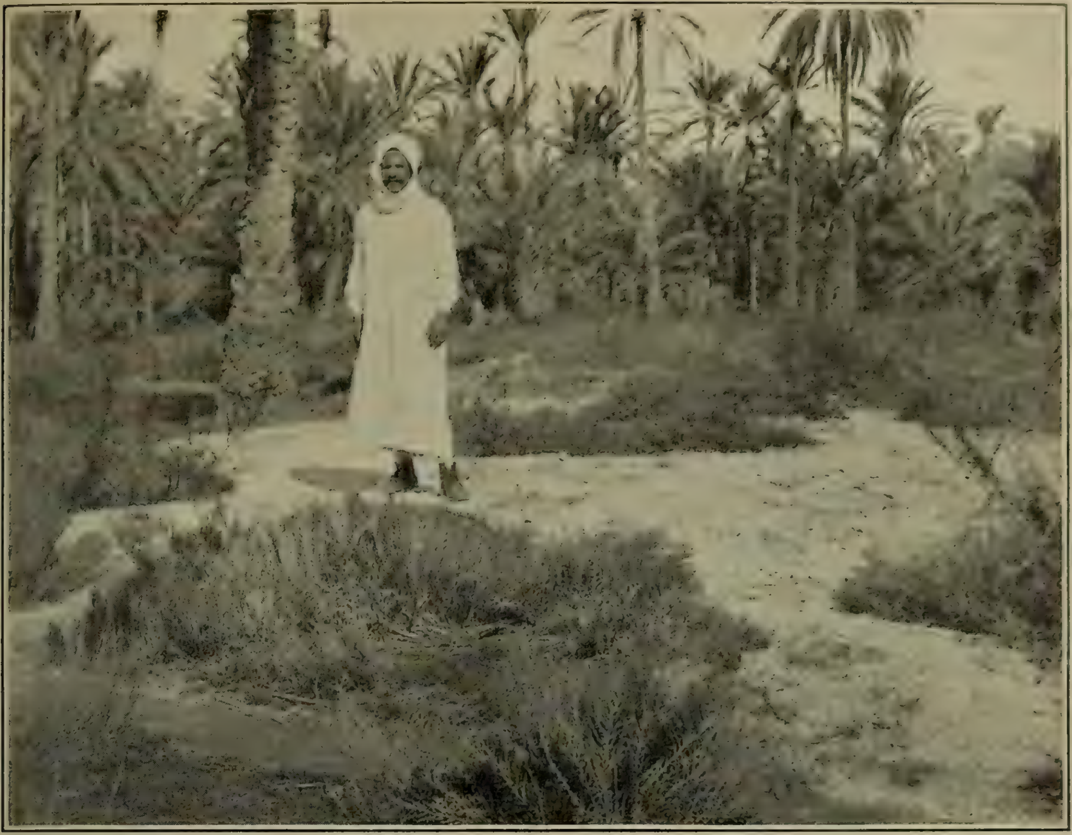


FIG. 1.—ALKALI LAND IN THE MIDST OF TOZER OASIS.

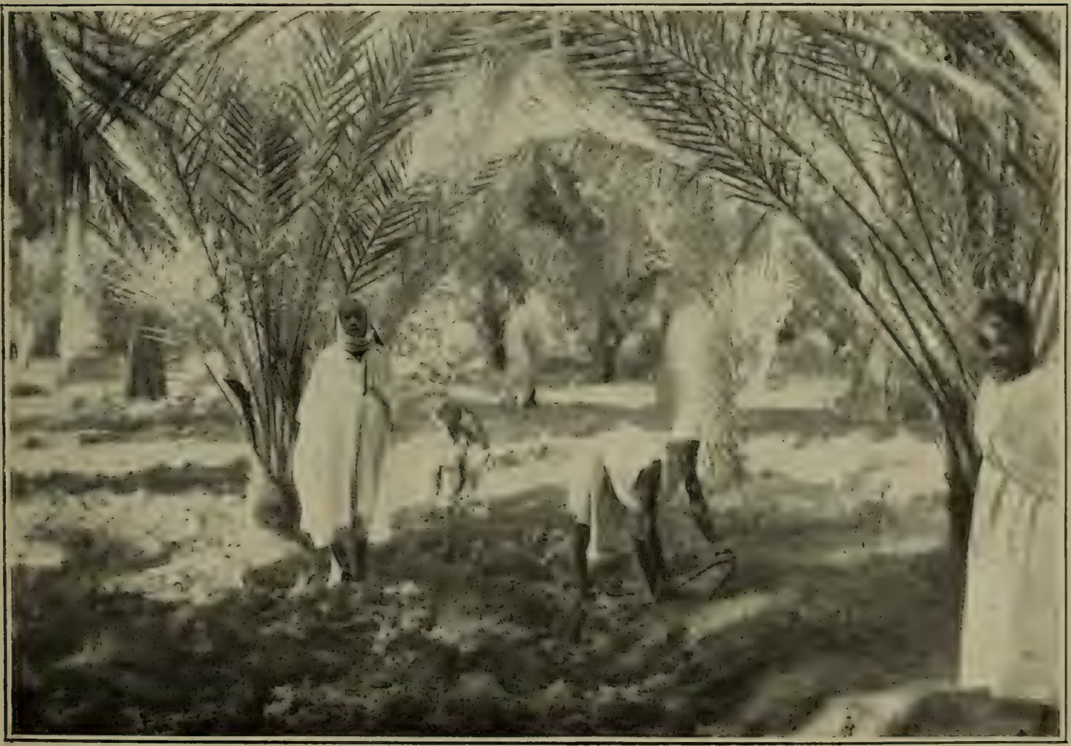
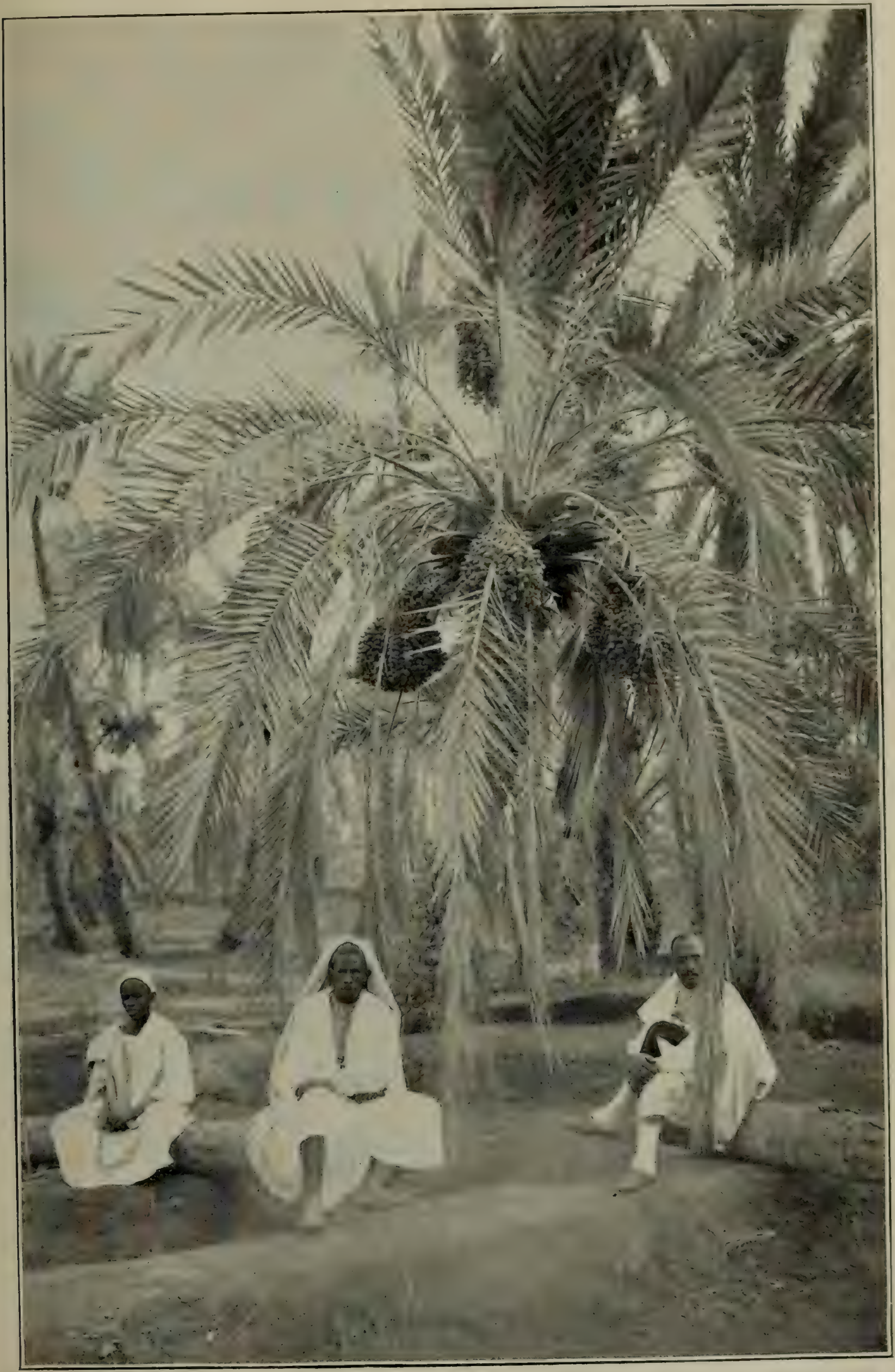


FIG. 2.—WORKING THE SOIL OF A DATE GARDEN WITH THE "MESSAH", OR SHORT-HANDLED HOE.



DATE PALM, SHOWING "STRADDLING" OF FRUIT CLUSTER TO PREVENT THE BREAKING OF THE STALK.

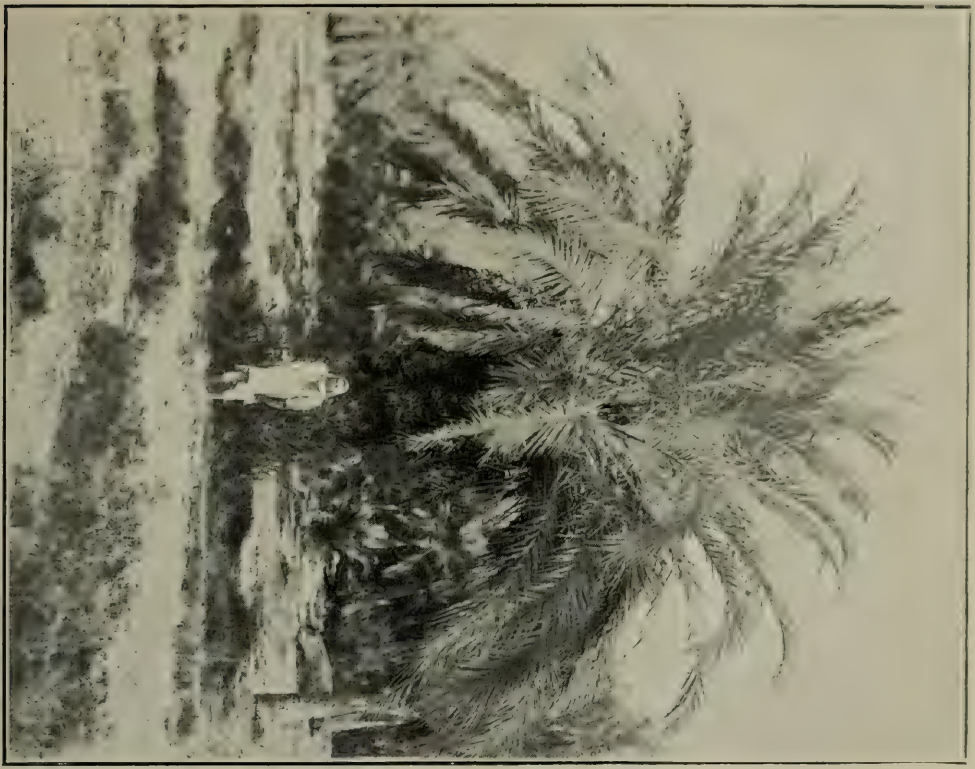


FIG. 1.—TRONJA PALM SHOWING CHARACTERISTIC DROOPING, CURVED LEAVES.

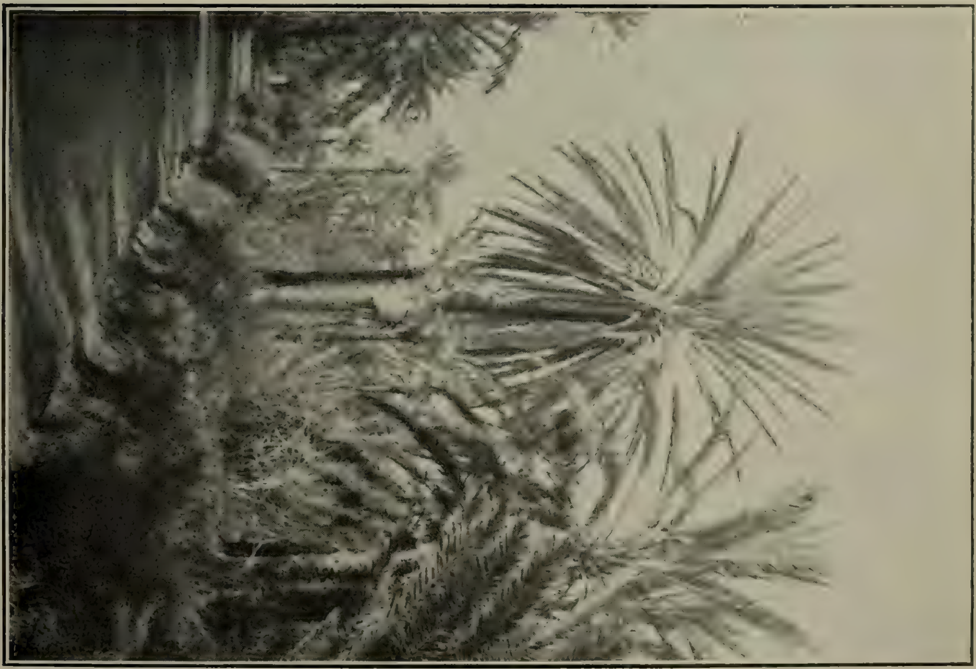


FIG. 2.—A TYPICAL MALE DATE PALM SHOWING NUMEROUS LEAVES.

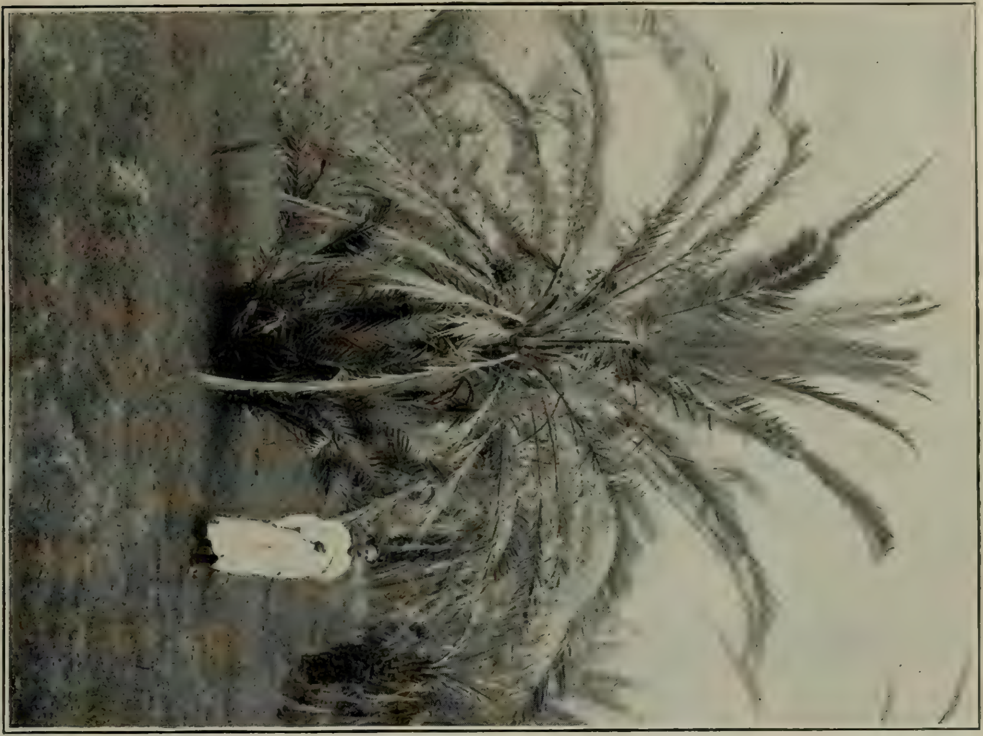


FIG. 1.—MENAKHER PALM WITH NUMEROUS SMALL SUCKERS.

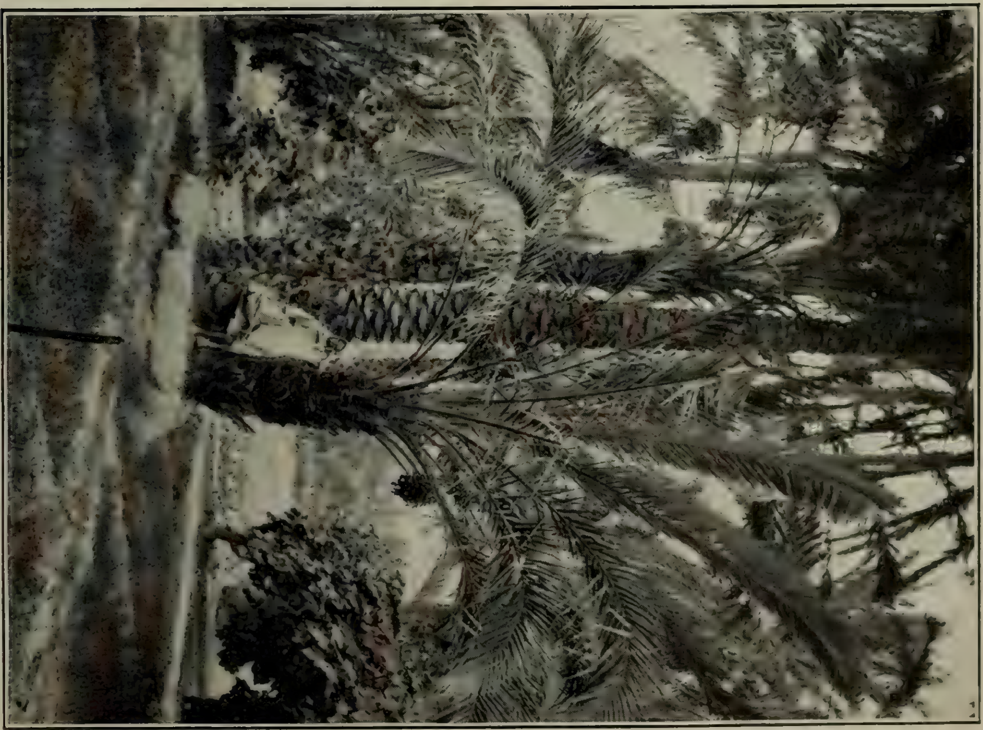


FIG. 2.—OLD MENAKHER PALM WITH TWO LARGE FRUITING SUCKERS.

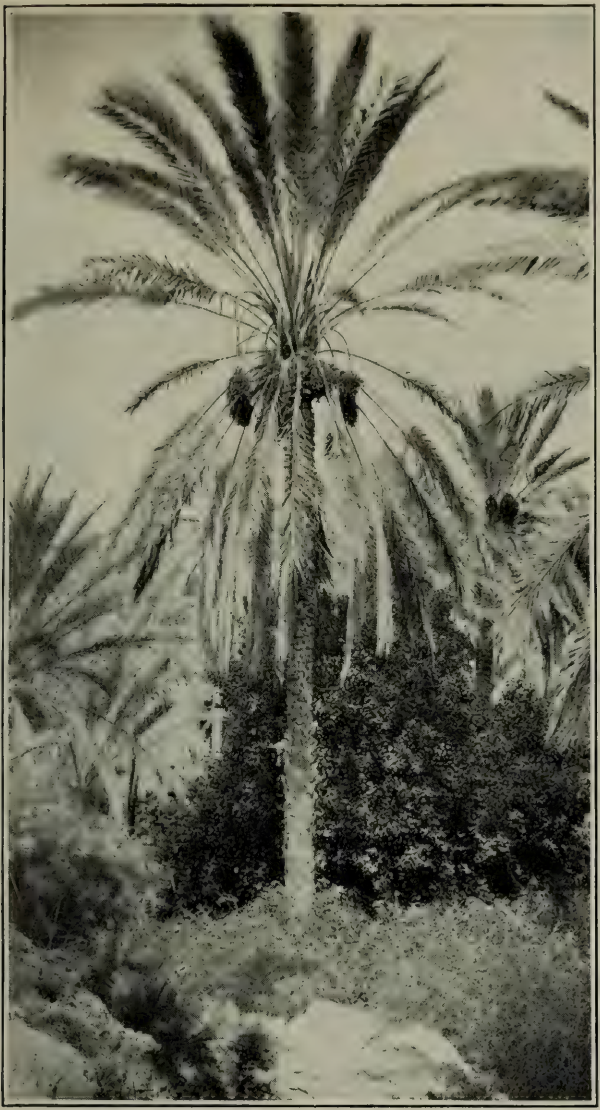


FIG. 1.—DEGLET NOOR PALM.

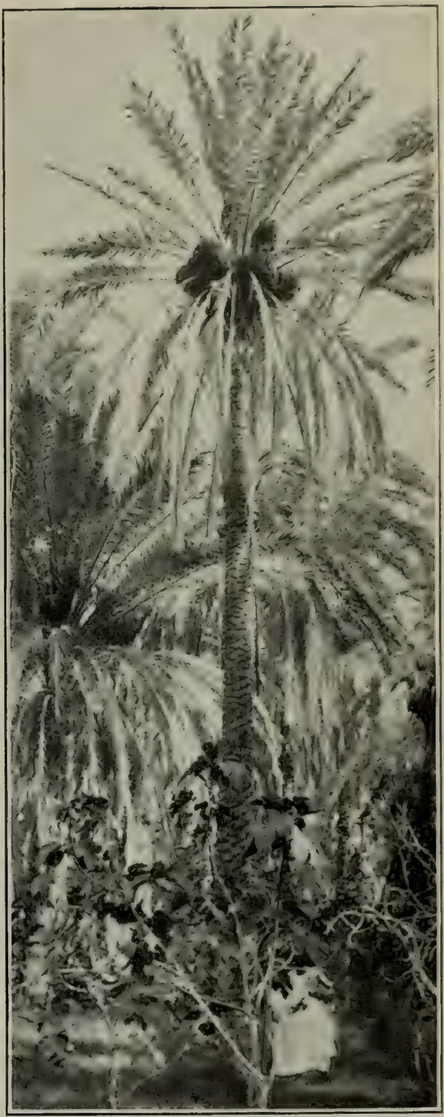


FIG. 2.—LAGOO PALM.

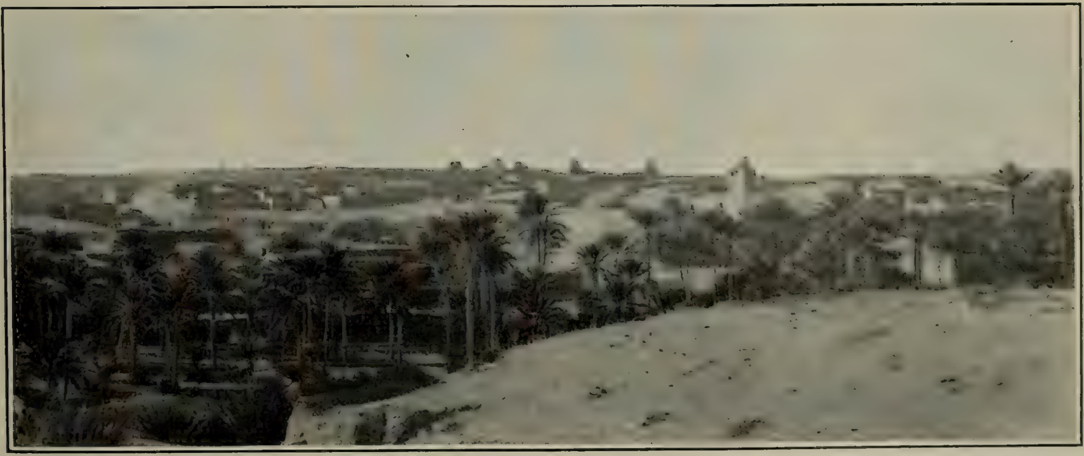


FIG. 3.—THE TOWN OF NEFTA, WITH DATE GARDEN IN LEFT FOREGROUND.

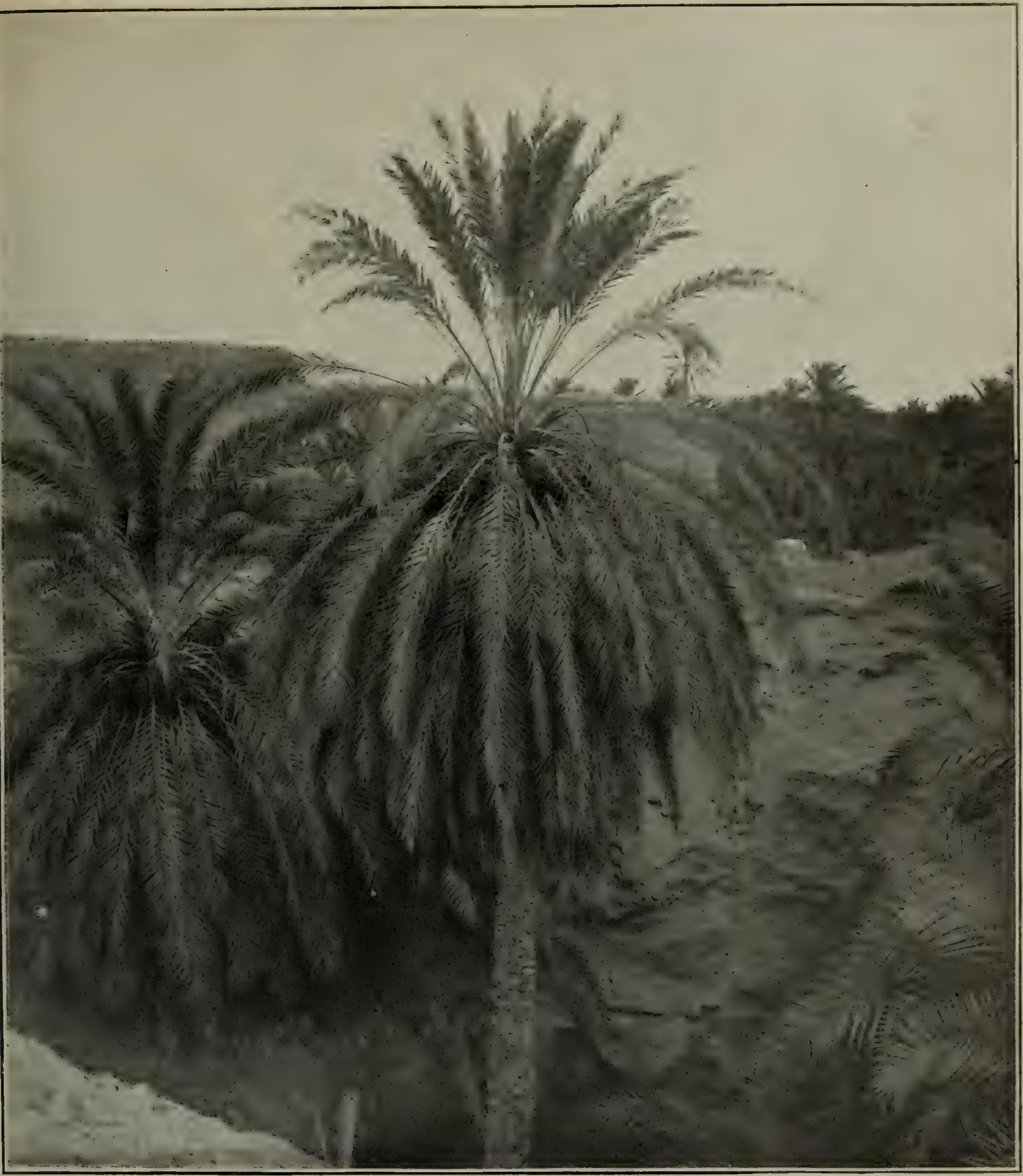


FIG. 1.—FTEEMY PALMS, EL OUDIANE.

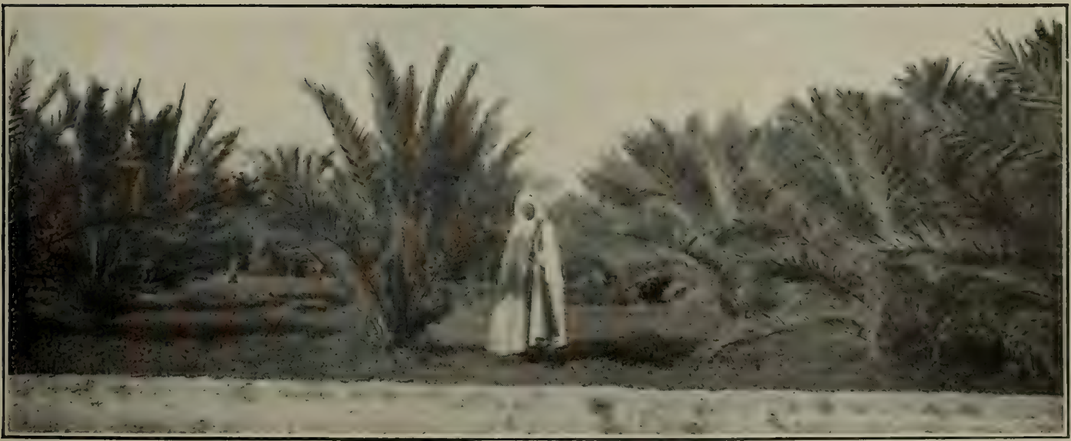
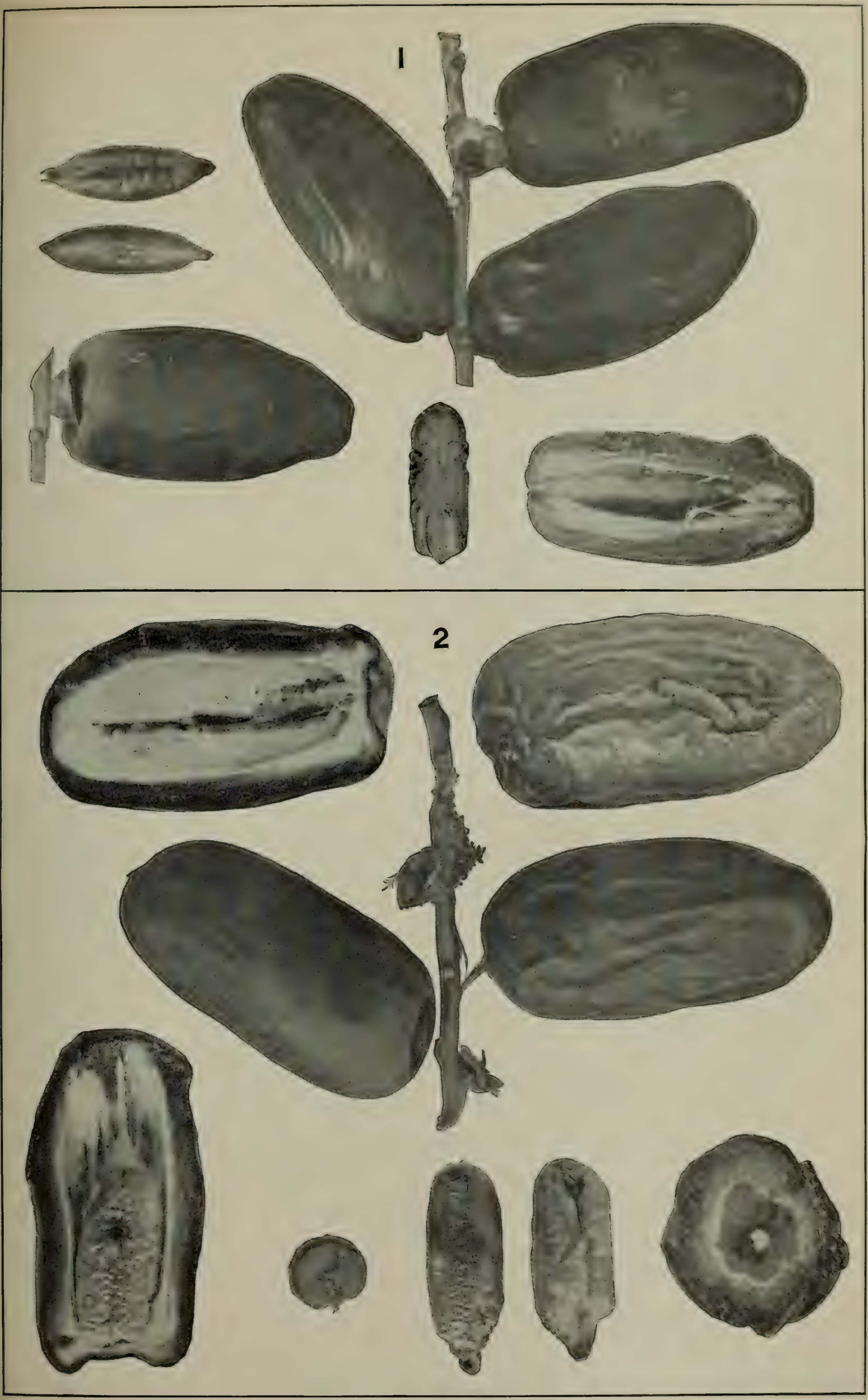


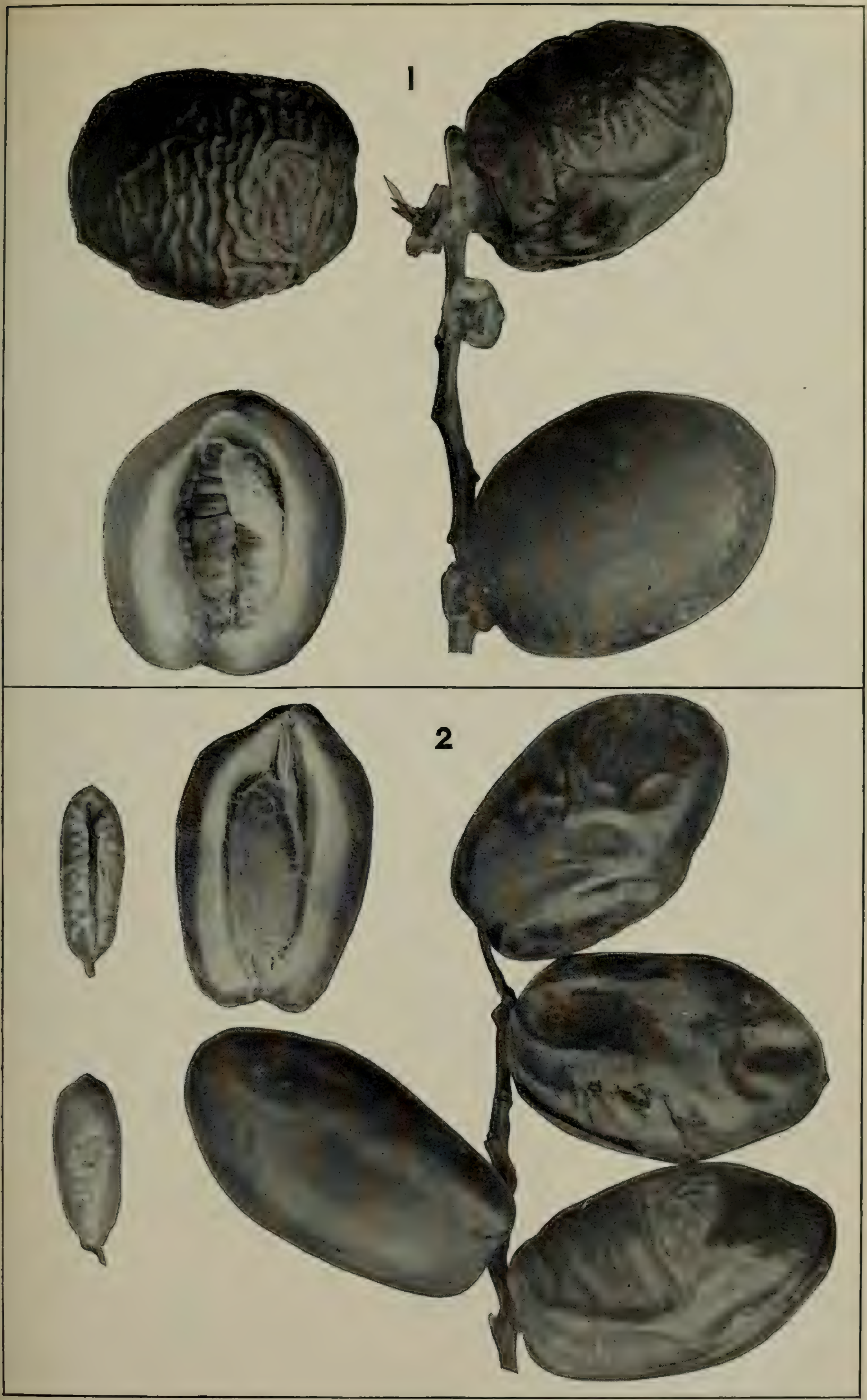
FIG. 2.—PLANTATION OF SIX-YEAR-OLD DATE PALMS AT NEFTA.

A Fteemy palm in the foreground.



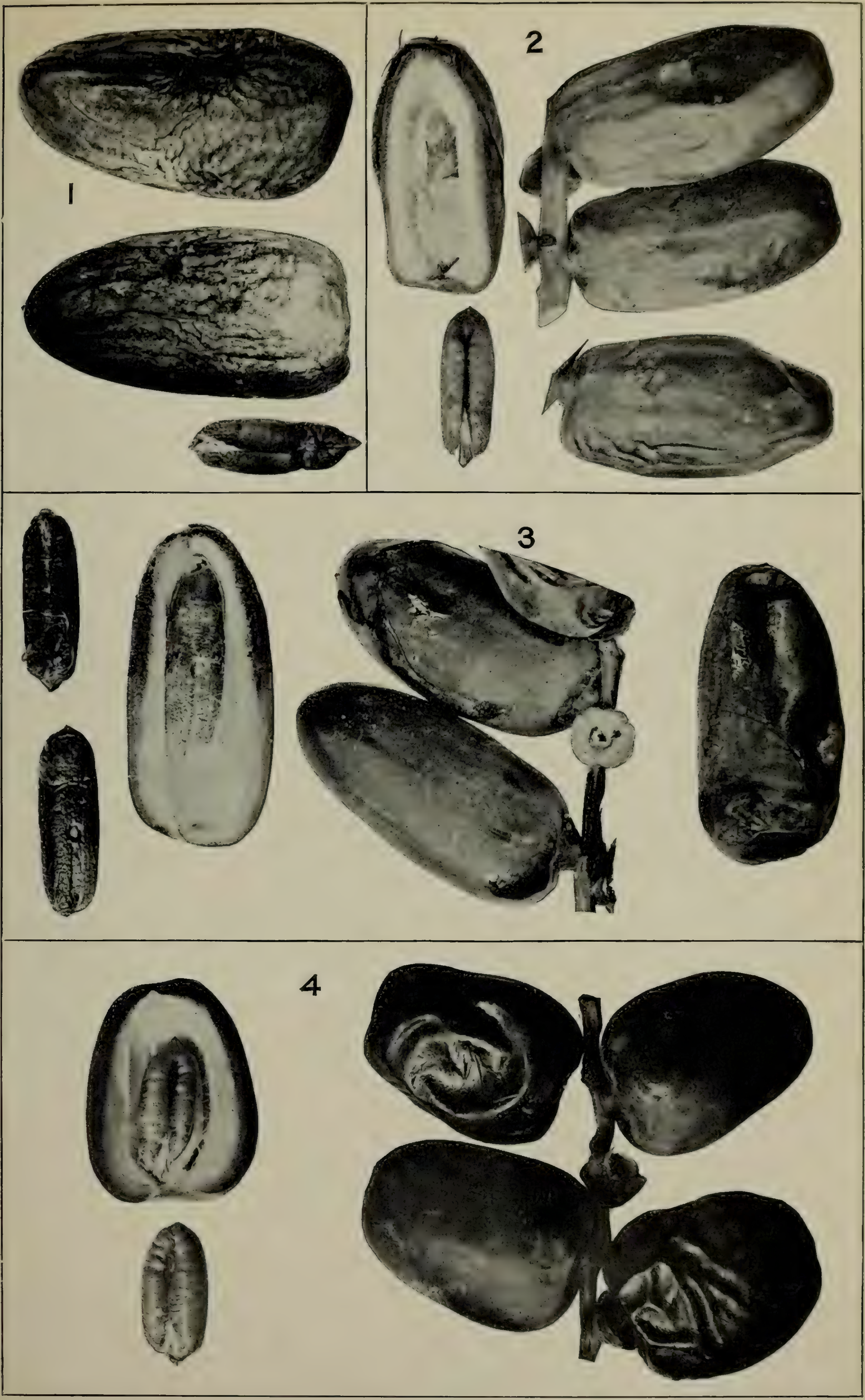
DATES, NATURAL SIZE.

1.—Deglet Noor variety. 2.—Menakher variety.



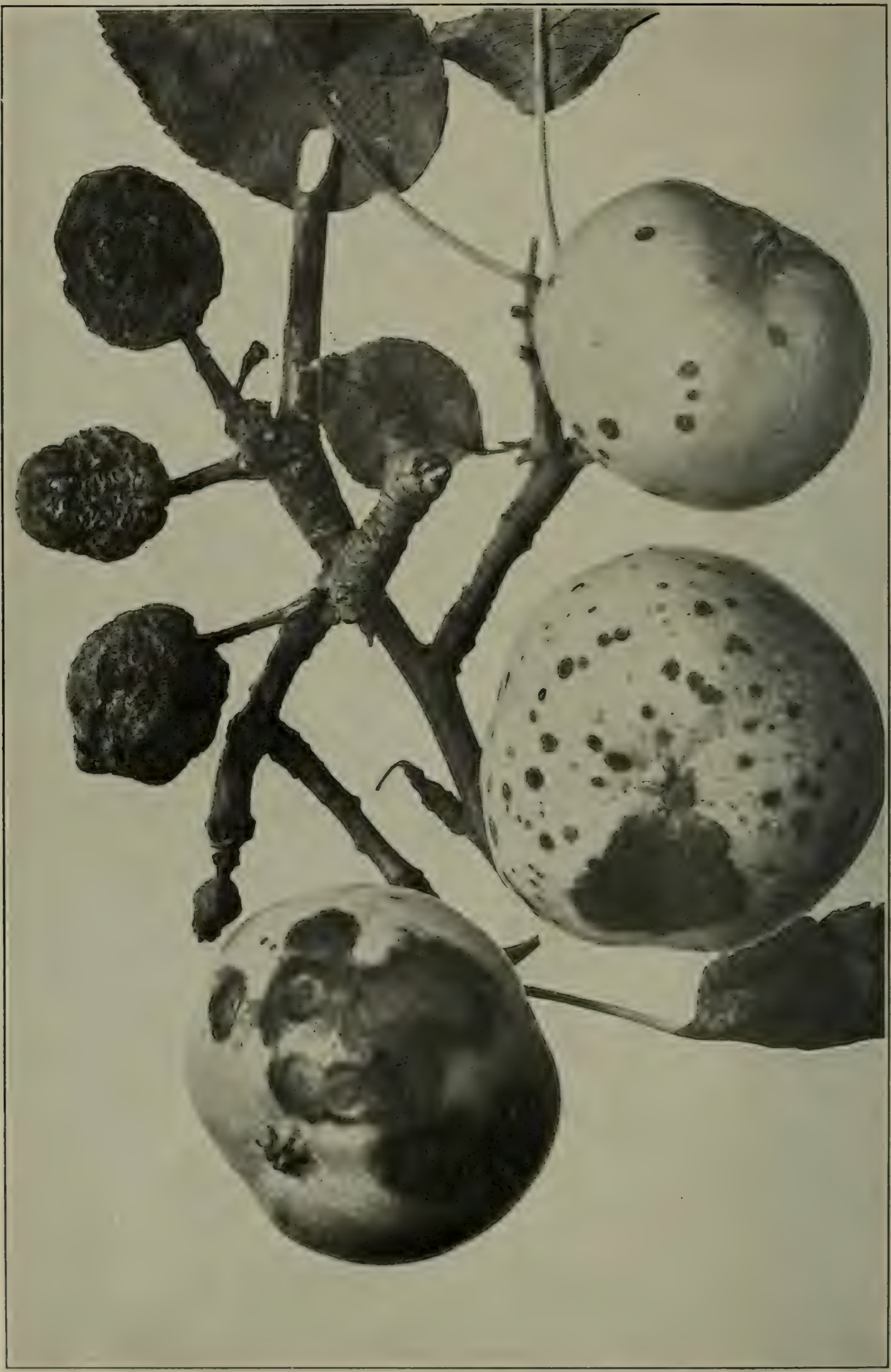
DATES, NATURAL SIZE.

1.—Tronja variety. 2.—Boo Affar variety.



DATES, NATURAL SIZE.

1.—Horra variety. 2.—Kenta variety. 3.—Fteemy variety. 4.—Mokh Begry variety.



APPLES BADLY AFFECTED WITH BITTER-ROT ON THE SAME TWIG WITH MUMMIES OF THE PRECEDING YEAR'S CROP.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 93.

B. T. GALLOWAY, *Chief of Bureau.*

THE
CONTROL OF APPLE BITTER-ROT.

BY

W. M. SCOTT, PATHOLOGIST.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

ISSUED MARCH 14, 1906.

239407
13 / 1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

BUREAU OF PLANT INDUSTRY.

B. T. GALLOWAY,
Pathologist and Physiologist, and Chief of Bureau.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

ALBERT F. WOODS, *Pathologist and Physiologist in Charge, Acting Chief of Bureau in Absence of Chief.*

BOTANICAL INVESTIGATIONS.

FREDERICK V. COVILLE, *Botanist in Charge.*

FARM MANAGEMENT.

W. J. SPILLMAN, *Agriculturist in Charge.*

POMOLOGICAL INVESTIGATIONS.

G. B. BRACKETT, *Pomologist in Charge.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

A. J. PIETERS, *Botanist in Charge.*

ARLINGTON EXPERIMENTAL FARM.

L. C. CORBETT, *Horticulturist in Charge.*

INVESTIGATIONS IN THE AGRICULTURAL ECONOMY OF TROPICAL AND SUBTROPICAL PLANTS.

O. F. COOK, *Bionomist in Charge.*

DRUG AND POISONOUS PLANT INVESTIGATIONS, AND TEA CULTURE INVESTIGATIONS.

RODNEY H. TRUE, *Physiologist in Charge.*

DRY LAND AGRICULTURE AND WESTERN AGRICULTURAL EXTENSION.

CARL S. SCOFIELD, *Agriculturist in Charge.*

EXPERIMENTAL GARDENS AND GROUNDS.

E. M. BYRNES, *Superintendent.*

SEED LABORATORY.

EDGAR BROWN, *Botanist in Charge.*

J. E. ROCKWELL, *Editor.*
JAMES E. JONES, *Chief Clerk.*

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

SCIENTIFIC STAFF.

ALBERT F. WOODS, *Pathologist and Physiologist in Charge.*

ERWIN F. SMITH, *Pathologist in Charge of Laboratory of Plant Pathology.*
HERBERT J. WEBBER, *Physiologist in Charge of Laboratory of Plant Breeding.*
WALTER T. SWINGLE, *Physiologist in Charge of Laboratory of Plant Life History.*
NEWTON B. PIERCE, *Pathologist in Charge of Pacific Coast Laboratory.*
M. B. WAITE, *Pathologist in Charge of Investigations of Diseases of Orchard Fruits.*
MARK ALFRED CARLETON, *Cerealist in Charge of Grain Investigations.*
KARL F. KELLERMAN, *Physiologist in Charge of Laboratory of Plant Physiology.*
HERMANN VON SCHRENK, *in Charge of Mississippi Valley Laboratory.*
ERNST A. BESSEY, *Pathologist in Charge of Subtropical Laboratory.*
C. O. TOWNSEND, *Pathologist in Charge of Sugar Beet Investigations.*
T. H. KEARNEY, A. D. SHAMEL, *Physiologists, Plant Breeding.*
P. H. DORSETT, CORNELIUS L. SHEAR, WILLIAM A. ORTON, W. M. SCOTT, E. M. FREEMAN, *Pathologists.*
E. C. CHILCOTT, *Expert in Cultivation Methods, Grain Investigations.*
C. R. BALL, *Assistant Agrostologist, Grain Investigations.*
JOSEPH S. CHAMBERLAIN,[a] J. ARTHUR LE CLERC,[b] *Physiological Chemists, Grain Investigations.*
FLORA W. PATTERSON, *Mycologist.*
CHARLES P. HARTLEY, CHARLES J. BRAND, *Assistant Physiologists.*
DEANE B. SWINGLE, GEORGE G. HEDGCOCK, PERLEY SPAULDING, P. J. O'GARA, FLORENCE HEDGES, GEORGE F. MILES, W. W. GILBERT, JOHN R. JOHNSTON, ALICE C. HASKINS, *Scientific Assistants, Plant Pathology.*
T. RALPH ROBINSON, T. D. BECKWITH, *Scientific Assistants, Plant Physiology.*
JESSE B. NORTON, ERNEST B. BROWN, LEONARD L. HARTER, WIGHTMAN W. GARNER, *Scientific Assistants, Plant Breeding.*
HENRY A. MILLER, LESLIE A. FITZ, A. H. LEIDIGH, H. F. BLANCHARD, VICTOR L. COREY, *Scientific Assistants, Grain Investigations.*
W. W. COBEY, *Tobacco Expert.*
JOHN O. MERWIN, *Scientific Assistant.*

---

[a] Detailed to Bureau of Chemistry.
[b] Detailed from Bureau of Chemistry.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., December 21, 1905.

Sir: I have the honor to transmit herewith the manuscript for a bulletin entitled "The Control of Apple Bitter-Rot," by Mr. W. M. Scott. This paper was submitted by Mr. A. F. Woods, Pathologist and Physiologist of the Bureau, with a view to publication.

This Bureau has for a number of years been investigating this serious disease, which nearly every year causes great loss to apple growers. The loss some years has been estimated to be more than $10,000,000. Although many attempts have been made to control the disease by the ordinary spraying methods, the results have been unsuccessful. Mr. Scott has discovered the reason for these failures, and the results of his investigations during the present season (which has been exceedingly favorable for the development of bitter-rot) indicate that the disease can be successfully controlled at a nominal cost. It now remains, through demonstration experiments to be conducted in the various apple districts, to bring the method into general use.

I respectfully recommend that this paper be published as Bulletin No. 93 of the series of this Bureau.

The accompanying illustrations are essential to a clear understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

Page.

Introduction 7

The disease and its cause 8

  The diseased spots on the apple 8

  The bitter-rot fungus 9

    The mycelium 9

    Summer spores 10

    Ascospores 10

    Germination of the spores 10

  Bitter-rot cankers on the branches 11

  Source of infection and spread of the disease 11

  Influencing conditions 12

    Weather 12

      Moisture 13

      Temperature 13

    Susceptibility of different varieties 14

Remedial measures 15

The Virginia experiments 17

  The experimental trees 18

  The plan of the experiment 19

    Object 19

    Spraying scheme 19

  Weather conditions attending the experiment 20

  Results 21

  Beneficial effects of spraying 25

  Effect of the treatment on other diseases 26

    Scab 26

    Leaf-spot 27

    Sooty-blotch 27

  Injurious effects of the treatment 27

    Russeting 27

    Coating of Bordeaux mixture 28

Commercial operations 28

  Results in several orchards 28

Preparation of Bordeaux mixture 31

Method of applying Bordeaux mixture 32

Conclusions and recommendations 32

Description of plates 36

ILLUSTRATIONS.

PLATES.

Page.
PLATE I. Apples badly affected with bitter-rot on the same twig with mummies of the preceding year's crop .... Frontispiece.
II. The microscopic characters of the bitter-rot fungus in various stages. 36
III. Fig. 1.—Crop of apples from one tree of Plot 3, sprayed seven times. Fig. 2.—Crop from an unsprayed tree (Check A) 36
IV. Fig. 1.—Apples harvested from one tree of Plot 6, sprayed ten times. Fig. 2.—Crop from an unsprayed tree (Check D) 36
V. Fig. 1.—Apples harvested from one tree of Plot 1, sprayed three times; applications made too early. Fig. 2.—Crop of apples from one tree of Plot 12, sprayed four times; applications made too late.. 36
VI. Fig. 1.—A Yellow Newtown apple badly affected with bitter-rot, and another recently mummified by the fungus. Fig. 2.—The crop from one tree of Plot 16, sprayed four times at the right period... 36
VII. An untreated apple tree (Check A), with the bulk of its crop on the ground at picking time 36
VIII. Fig. 1.—Platform and equipment for making Bordeaux mixture. Fig. 2.—The spraying outfit in operation 36

TEXT FIGURE.

FIG. 1. Plat of the block of trees used in the experiment 18

THE CONTROL OF APPLE BITTER-ROT.

INTRODUCTION.

Accounts of severe losses of the apple crop of the United States caused by bitter-rot (*Glomerella rufomaculans* (Berk.) Spaulding & von Schrenk) date back to 1870, and since that time destructive outbreaks of this disease have occurred at frequent intervals with apparently increasing severity until a loss of several million dollars in a single season is not uncommon. An epidemic occurred in 1900, when it was estimated that the damage to the apple crop of the United States was $10,000,000,[a] and in 1902 the attacks of the fungus were again exceedingly severe.

Although the fungus causing this disease occurs in nearly every apple-growing State in the eastern part of the United States, severe losses from it have been confined to the southern half of the apple belt, Missouri, Illinois, Arkansas, Virginia, West Virginia, and Kentucky suffering especially in recent years.

This disease has had the attention of the Department of Agriculture for a number of years. In the Report of the Chief of the Section of Vegetable Pathology for 1887[b] appeared the first economic discussion of the disease by an American writer, followed in 1891[c] by a more extensive account of the fungus by Miss E. A. Southworth. In 1903 Messrs. von Schrenk and Spaulding,[d] of the Mississippi Valley Laboratory of the Bureau, published a general account of the bitter-rot disease with a description and life history of the fungus causing it.

In 1903 the attention of the Bureau of Plant Industry was called to an outbreak in Virginia and West Virginia, and the writer was detailed to investigate the trouble and arrange for remedial experiments. During the months of August and September (1903) a number of orchards in each of these States were visited, and it was found that, although several other good varieties were affected, the highly prized Yellow Newtown (also known as Albemarle Pippin) was, as usual, the greatest sufferer. In some cases the destruction was complete, and to find as much as 50 per cent of the fruit of this variety harvested in good condition was exceptional. The Yellow Newtown growers of this section had had a similar experience with the crops of 1901 and 1899 (two and four years previous), and some were on the point of abandoning their orchards in despair, one man going so far as to cut down his trees. It seemed, therefore, especially desirable for the Bureau to determine the best methods for combating this disease and to obtain data upon which definite recommendations could be based. Accordingly a series of experiments was planned, which were carried out in the orchards of Mr. W. H. Goodwin, at Avon, Va., to whom the Department is much indebted for valuable services in facilitating the work. The work was outlined and some spraying done in the spring of 1904, but this being the "off year" it soon developed that there would be no crop of apples in that section, and the actual work reported upon in this paper was not commenced until the spring of 1905.

---

[a] Woods, A. F. Annual Reports, Department of Agriculture, 1901, p. 47.

[b] Annual Report of the Commissioner of Agriculture, 1887, pp. 348–350, Pl. III.

[c] Journal of Mycology, VI, pp. 164–173, Pl. XVI.

[d] Bul. 44, Bureau of Plant Industry, U. S. Department of Agriculture, 1903.

THE DISEASE AND ITS CAUSE.

A detailed account of the disease and the fungus causing it having appeared in a previous bulletin of this Bureau,[a] many details will be omitted in the following discussion, the attempt being made to include only those facts with special bearing on the subject of this paper.

THE DISEASED SPOTS ON THE APPLE.

The diseased spots are usually a quarter to a half inch in diameter before the fruit grower ordinarily notices them, but they first appear as very small, yellowish-brown, sometimes watery specks, frequently bordered with a ring of purple-red. The purplish margin is especially prominent on spots that are retarded by cool weather, and many late infections appear only as red or purplish specks, never developing farther on account of adverse conditions. On the other hand, the purplish coloration is likely to be entirely absent from a spot that is developing rapidly under favorable conditions. As the spot enlarges and grows older it becomes dark-brown in the center, shading off into a light watery margin. It is circular in outline, with a well-defined margin, and soon becomes sunken. (See Pl. I, and Pl. VI, fig. 1.)

When the spots are about one-half inch in diameter, fruiting pustules begin to appear in the form of small black dots slightly raised and usually arranged in concentric rings (Pl. VI, fig. 1). These pustules soon break through the skin (Pl. II, *b*), discharging pink, sticky spore masses, which are readily washed off by dews and rains. As the disease progresses, other rings of pustules appear and give forth spores in great abundance. When the pink spore masses are washed away the pustules appear as black ragged openings through the skin of the apple. An apple may have only one diseased spot, but in a serious outbreak there are usually several, and it is not uncommon to see a fruit literally peppered with points of infection. During the past season the writer counted 1,200 on a single apple and estimated 1,000 on each of several others. When so numerous, these spots are at first raised, appearing as small brown blisters on the skin of the apple, and are frequently so arranged as to suggest that the points of infection had followed drops of water trickling down the sides of the apple, the specks being distributed evenly over the upper or stem end, from which the specked areas extend in strips toward the calyx end.

---

[a] Von Schrenk and Spaulding, l. c.

When a number of spots appear on a single apple, they soon coalesce, and three or four, gaining the ascendency, envelop the others and retain their circular shape, each producing its rings of fruiting pustules. Finally the entire fruit is converted into a dark-brown, shriveled, and wrinkled mummy, which may hang on the tree a year or more. (Pl. I, and Pl. VI, fig. 1.) However, the majority of the affected fruits fall to the ground before they are half rotten, and their decomposition is hastened by scavenger insects and decay fungi.

THE BITTER-ROT FUNGUS.

The bitter-rot disease is due to a fungus which has received the botanical name *Glomerella rufomaculans* (Berk.) Spaulding & von Schrenk,[a] but which has been known until recently as *Gloeosporium fructigenum* Berk.[b]

This microscopic plant, developing from a spore that has found its way to the apple, penetrates the skin in the form of a minute tube, which immediately begins to branch and grow rapidly in every direction. This mycelium absorbs its nourishment from the cells of the apple, killing them and thus producing the brown sunken spots known as bitter-rot.

The mycelium.—The diseased tissue is filled in the intercellular spaces with pale, delicate, much-branched threads of mycelium, which are septate, slightly granular, and chiefly 4 to 6 μ in diameter. (Pl. II, *4*, *a*.) Under favorable conditions the mycelium grows very rapidly, killing the fruit cells almost as fast as it enters the healthy tissue. It grows toward the center of the apple at a rate about equal to its lateral progress. After a time these threads become congregated just beneath the surface at certain points almost equidistant from the point of infection, forming stromata, which give rise to upright bundles of interwoven branches. These are the spore-bearing hyphæ, which rupture the skin and give forth pink masses of conidia, or summer spores. (See Pl. II, *6*.)

---

[a] Von Schrenk and Spaulding. The Bitter-Rot of Apples, Bul. 44, Bureau of Plant Industry, U. S. Dept. of Agriculture, p. 29. Saccardo (Annales Mycologici, 2, p. 198) thinks the name should be *Glomerella fructigena* (Clinton) Sacc.

[b] Berkeley, M. J. *Gloeosporium fructigenum*, n. s., Gardeners' Chronicle, 1856, p. 245.

Summer spores.—It is thought to be chiefly by means of summer spores that this fungus is propagated and disseminated, and countless millions of them may be produced from one rotton spot. They are produced one after another by abstriction from the ends of the fruiting branches of the fungus, and, as previously explained, exude through the ruptured skin of the apple in pink, sticky masses easily visible to the naked eye. They are readily washed off by the action of dew and rain, but upon drying become hard and glued to the skin of the apple.

A microscopic examination shows these spores to be oblong, almost cylindrical, one-celled bodies with a delicate pale-green color and granular contents. They vary in size, as also in shape, but normally measure 4–5×10–15 μ. (Pl. II, *4*, *a*.)

Ascospores.—In addition to the conidia, or summer spores, which are produced so rapidly and in such great numbers, another type of spore is produced on the old rotten apples in the autumn and probably also the following spring. These ascospores, measuring about 5×20 μ (Pl. II, *2*), are scarcely distinguishable from the summer spores, but are usually slightly curved and are borne in little sacs containing 8 spores each. These sacs, or asci (Pl. II, *1*), are produced inside of little brownish spore cases (perithecia) embedded in black nodules of mycelium on the surface of the rotten apple or mummy. This constitutes the mature stage of the bitter-rot fungus as first discovered by Clinton,[a] and is probably a means of carrying the fungus over winter and starting infection the following spring. Von Schrenk and Spaulding[b] found it on limb cankers as well as in artificial cultures. The writer secured this stage of the fungus on a number of artificially infected apples in the laboratory about three weeks after inoculation, and it developed on a few rotten apples brought in from the orchard and placed in a moist chamber. It also developed abundantly in artificial cultures on sterilized potato and nutrient agar within six weeks after inoculation.

Germination of the spores.—Placed in a drop of water under a microscope, both conidia and ascospores may be seen to germinate within three or four hours, each spore throwing out one or two, sometimes three, germ tubes. (Pl. II, *3* and *5*.) During germination a cross septum usually develops in the center of the spore, which soon becomes emptied of its contents. These germ tubes grow very rapidly, reaching several times the length of the spore within an hour after germination, and then begin branching.

There is some question as to how the threads from the germinating spore find their way through the skin of the apple. The most common belief expressed by writers upon this subject is that the fungus enters through insect punctures or some other abrasion of the skin, and it has also been suggested that the fungus could probably enter through the unbroken skin. The writer's observations would indicate that a wound is not at all necessary for successful infection and that the fungus most commonly penetrates the skin. Several hundred points of infection were examined without finding any indication of a previous puncture. A large percentage of the apples on the untreated trees used as checks in the spraying experiment had from one hundred to a thousand points of infection, and in many cases the spots were so thick that when only one-sixteenth of an inch in diameter they overlapped. In the laboratory, infections were easily made by dropping water containing spores on the unbroken skin of an apple in a moist chamber.

---

[a] Clinton, G. P. Apple Rots in Illinois, Bul. 69, Ill. Agr. Exp. Sta., 1902, pp. 206–211, Pl. J.

[b] Bul. 44, Bureau of Plant Industry, U. S. Department of Agriculture, 1903.

BITTER-ROT CANKERS ON THE BRANCHES.

In 1902 it was discovered by Mr. R. H. Simpson, of Illinois, that limb cankers were associated with outbreaks of bitter-rot. Messrs. Burrill and Blair[a], of the Illinois Agricultural Experiment Station, and Messrs. von Schrenk and Spaulding[b], of the Mississippi Valley Laboratory of the Bureau of Plant Industry, working independently, soon established the relationship of these cankers to the disease on the fruit and proved by inoculation tests that these cankers were caused by the same fungus that attacks the fruit.

In describing this form, von Schrenk and Spaulding[c] state that "The cankers found on apple trees in Illinois appear as blackened depressions on apple limbs of various sizes, from last year's fruit spurs to limbs 3 to 4 inches in diameter. Thus far the cankers have not been found on the main trunk. On these limbs rounded or oblong sooty-black sunken spots occur from one to several inches long, which have more or less ragged edges." Limb cankers occur abundantly in the Virginia orchards, but the writer has so far been unable to find the bitter-rot fungus associated with any of them. However, limbs of young apple trees on the grounds of the United States Department of Agriculture inoculated with bitter-rot spores rapidly developed these cankers.

SOURCE OF INFECTION AND SPREAD OF THE DISEASE.

The question as to the chief source of the first infection each year has not been satisfactorily settled, nor is it definitely known how the fungus is spread from tree to tree and from orchard to orchard. It seems, however, that the mummied fruit and the limb cankers are both instrumental in carrying the fungus over winter and starting the annual infection, and that insects play an important rôle in the spread of the spores.

---

[a] Circ. 58, Ill. Agr. Exp. Sta., July, 1902, and Bul. 77, Ill. Agr. Exp. Sta., 1902, pp. 355–357.

[b] Bul. 44, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1903, pp. 29–36.

[c] L. c., p. 31.

During the season of 1903 and again in 1905 the writer visited a number of infected orchards in Virginia and West Virginia, making special observations upon this problem. The results lead to the conclusion that the overwintering mummies hanging on the trees constitute the chief source of infection, at least in this particular region. In the majority of cases examined a mummy could be found in the upper portion of the infected area, but in no case was there found associated with such outbreaks any cankers that could be identified as bitter-rot cankers. However, from observations made in the Middle West, Burrill and Blair[a] and von Schrenk and Spaulding[b] conclude that the canker is the chief source of early infection, the fungus being held over winter in the diseased limbs and producing spores for the infection of the new crop of apples. Hasselbring[c] demonstrated that the fungus of bitter-rot remains alive over winter in the mummied apples. It seems possible that the mature spore form of the fungus discovered by Clinton may develop the following spring in the mummied fruits, starting the infection on the new crop.

After one apple on a tree becomes diseased and begins to produce spores, further infections may readily take place through the medium of raindrops which splash the spores to adjacent fruits, and heavy dews may wash the spores to the apples below. Insects are also undoubtedly instrumental in disseminating the disease,[d] and they are possibly the chief carriers of the spores from tree to tree. On the other hand the rapidity with which the disease frequently spreads over an orchard, practically destroying the entire crop within a few days, suggests the idea that the spores are carried on the wind, and indeed they seem to be omnipresent in the bitter-rot districts, only awaiting suitable weather conditions. But the spore masses being sticky when wet and glued to the skin of the apple when dry, there seems to be little or no chance for the wind to carry the spores.

INFLUENCING CONDITIONS.

WEATHER.

The predominating conditions that influence the development of bitter-rot are temperature and humidity. A few days of hot showery weather may start an epidemic that will destroy the entire crop of certain varieties, provided the fungus is present.

---

[a] Bul. 77, Ill. Agr. Exp. Sta., p. 356. 1902.

[b] Bul. 44, Bureau of Plant Industry, U. S. Department of Agriculture, 1903, pp. 36–38.

[c] Burrill and Blair, l. c., p. 354.

[d] Clinton, G. C., Bul. 69, Ill. Agr. Exp. Sta., p. 197.

Moisture.—Moisture is not only necessary for the germination of the spores, but it favors the growth of the fungus and hastens spore production. In a moist atmosphere the spores are produced much more rapidly than when the air is dry. Moreover, rain is an active agent in the spread of the disease, splashing the spores from an affected apple to adjacent healthy fruits. Heavy dews followed by hot cloudy days with a humid atmosphere appear to make ideal conditions for the rapid development of this disease.

Temperature.—The fungus causing this disease is decidedly a hot-weather fungus and rarely is a serious pest north of latitude 40° N. July, August, and September are the three bitter-rot months, and a maximum temperature near 90° F. for several days in succession, coupled with suitable moisture conditions, is necessary to start a serious outbreak. Infection of some fruits may take place as early as the middle of June,[a] but the fungus grows slowly and fruits sparingly until the warmer weather of July increases its rate of development. In Virginia, on July 10, 1905, the writer observed bitter-rot spots covering a quarter to half of the apple. One specimen was somewhat more than half involved in rot, and the numerous rings of spore masses indicated that the fungus had been fruiting abundantly for days, and the infection had doubtless taken place a couple of weeks earlier. The variety was Yellow Newtown, and the fruit was scarcely more than half grown. The proper combination of heat, moisture, and an abundance of spores may not occur until August or September, or in some seasons not at all.

The fungus is so influenced by the heat of the sun, and perhaps by the light also, that the fruit on the south side of a tree may become badly affected before the disease is noticeable on the opposite side. Stinson[b] observed this fact, and in the Virginia orchards the writer found that almost invariably the fruit on the sunny side was destroyed first, and oftentimes a portion of the crop on the north side would escape when the destruction was complete on the south side. This held true not only in the particular orchard under experimentation, but in many orchards visited during the outbreak of 1903, and during the past season as well. Moreover, it was observed that fruit on the inside lower branches well protected from the sun was less attacked and often escaped when that on exposed portions of the same tree was destroyed. Owing perhaps to exposure to the sun there was a considerably higher percentage of rotten fruit on trees partly defoliated with leaf-spot fungi than in the case of trees with full foliage. Not only is the fruit on the sunny side of the tree worse affected, but the points of infection are more commonly located on the sunny side of the apple. Although infections were frequently found on the shaded side of the apple, in the majority of cases, according to the writer's observations during the past season, the rotten spots developed on the side exposed to the sun.

---

[a] See Burrill and Blair, Bul. 77, Ill. Agr. Exp. Sta., p. 332.

[b] Bul. 1, Missouri State Fruit Experiment Station, p. 6.

Cold is decidedly unfavorable to the fungus and it rarely does any damage during a cool season. An outbreak may be almost completely checked by a few days of cool weather, especially when the mean temperature remains below 70° F. Late infections that take place with the approach of cool fall weather usually remain as a brown speck encircled with a red or purplish ring. However, the fungus grows somewhat in the average fall weather, and if the temperature runs up to summer heat the picked fruit may rot considerably in piles or in barrels in the orchard. This emphasizes the desirability of rushing the fruit to cold storage or to market as soon as picked. In storage at a temperature of 35° F. the fungus does not grow, and spots previously started by inoculation develop no further after being stored at this temperature.

SUSCEPTIBILITY OF DIFFERENT VARIETIES.

There is a wide range of variation in the susceptibility of the different varieties of apples to injury from bitter-rot. In Virginia the Yellow Newtown (or Albemarle Pippin) is preeminently the most susceptible commercial variety. On the other hand, the Winesap is equally conspicuous for its resistance to the disease. When in close proximity to a badly rotting variety the Winesap may become infected, but the points of infection usually remain as mere specks, rarely growing to any size. The fungus does not seem to thrive on this variety and the production of spores is scant. The Ben Davis, although one of the most susceptible varieties in the Middle West, shows a comparatively slight tendency to rot in Virginia, rarely losing more than 25 per cent of its crop. York Imperial, the variety most extensively grown in the Valley of Virginia, is less susceptible than Ben Davis, being rarely attacked to a serious extent. The Grimes also rots very little.

From rather extensive observations made during 1903 and 1905 in Virginia and West Virginia the writer has prepared the accompanying list of varieties in the order of their susceptibility to bitter-rot. This list includes only such varieties as the writer examined in orchards where bitter-rot was found, and the data are not sufficiently extensive to be entirely reliable. Those varieties almost equally susceptible are grouped together, the first group representing those that frequently lose their entire crop, the second group those that in a bad season may be expected to lose 50 to 75 per cent of their crop, the third group those that rarely suffer more than 25 per cent loss, and the fourth group those on which the writer has never found the disease. These groups are as follows:

1. Yellow Newtown (or Albemarle Pippin), Shackleford, Bentley, Gibbs, and Missouri.

2. Arkansas Beauty, Limbertwig, Rhode Island, York Stripe, Huntsman, Pilot, Peck, Northern Spy, Jonathan, Northwestern Greening, Fall Cheese, Stark, Green Sweet, and Nero.

3. Grimes, Ben Davis, York Imperial, Gano, Arkansas, Ivanhoe, and Winesap.

4. Coffelt, Bismarck, Pewaukee, Stuart Golden, Pryor, Salome, Scarlet Cranberry, Oliver, Roxbury, Lankford, Loy, Ralls, Crawford, Carlough, and Akin.

Mr. F. W. Faurot, of the Missouri State Fruit Experiment Station, a collaborator of the Department of Agriculture, has kindly furnished the following information relative to the susceptibility of the different varieties of apples in the State of Missouri. He has arranged the varieties in their approximate order, with the most susceptible varieties first, in four classes, which do not necessarily coincide with the four classes given above. They are as follows:

1. Willow and Huntsman.

2. Ben Davis, Gano, Ingram, Smith, Rome, York Imperial, Clayton, Nickajack, and Nixonite.

3. Lowell, Porter, and Maiden Blush.

4. Arkansas, Arkansas Black, Jonathan, Grimes, Winesap, and Gilpin.

Mr. Faurot writes concerning this list as follows:

> In some seasons, however, this third group comes next to Willow and Huntsman, for when they bitter-rot at all the whole crop usually goes, especially Lowell and Porter. The reason I put them third is because some seasons they are out of the way before bitter-rot attacks them or begins to develop with any degree of severity.
>
> The varieties given constitute about all of those that are grown commercially in south Missouri. Aside from these, however, I have observed bitter-rot on very nearly every variety of apple that I have seen growing in the State, including such varieties as the ordinary Russets, Lawver, Northern Spy, Stevenson Pippin, Baldwin, and many others that are grown only a few trees in a place. I have never seen it, however, on White Pearmain, Yellow Transparent, or Red Astrachan. This is merely my personal observation, however, and I have no doubt that it occurs on these varieties the same as on others, although I have not seen it.

REMEDIAL MEASURES.

Although bitter-rot has been known in this country as a serious apple disease for at least thirty-five years, it seems that no attempt was made to find a remedy for it until about 1888. During that year Galloway[a] planned some experiments for the control of this disease, which were carried out by Mr. J. W. Beach, of Batavia, Ark. Sulphuret of potassium was the fungicide used, and the results reported were somewhat encouraging. In 1889 Galloway also directed a series of experiments on the treatment of this disease in Virginia. Potassium sulphid and ammoniacal copper carbonate were used, and Mr. George G. Curtis,[a] who did the spraying, reported good results from both.

---

[a] Galloway, B. T. Sulphuret of Potassium for Bitter-Rot of the Apple. Journal of Mycology, vol. V, 1889, pp. 37–38.

The investigations thus begun were soon followed with remedial experiments by several experiment stations workers, notably Alwood,[b] Garman,[c] Stinson,[d] and Whitten,[e] all of whom reported favorable though not entirely satisfactory results from spraying with copper compounds.

Since the severe outbreak of 1900, efforts to control this disease have been continued with renewed interest, and several papers reporting results of remedial experiments have been published. In 1901 Quaintance,[f] in writing of experiments conducted in Georgia the preceding year, stated that "the results are much in favor of four applications of Bordeaux, not only in quantity of fruit but in size and appearance, and, as developed later, in keeping quality." Some of the best results that have come to the writer's attention are those reported by Stinson in 1901.[g] One plot sprayed five times gave "59 per cent of the fruit free from bitter-rot," another sprayed four times gave "78 per cent of the fruit free from bitter-rot," while one check plot had only "1.6 per cent of the fruit free from bitter-rot" and another "14 per cent of the fruit free from bitter-rot." In 1902[h] the same writer published the results of another series of experiments showing beneficial results from spraying.

As a result of their investigation in 1902, Burrill and Blair[i] recommended a systematic search for and removal of the diseased fruits and infecting cankers or mummies, stating that "the canker and infested fruit should be removed, taking care not to distribute the infection in the process. This is of the utmost importance if the contagion is to be stopped." They also state that "the disease can be kept in check during the summer by repeated applications of Bordeaux mixture." In a paper read before a meeting of the Illinois State Horticultural Society, Burrill[a] reports experiments conducted in three counties of southern Illinois, showing that the disease yielded to applications of Bordeaux mixture. The results of these experiments indicate especially the importance of early spraying.

---

[a] Curtis, George G. Treatment of Bitter-Rot of the Apple. Bul. 11, Section of Vegetable Pathology, U. S. Dept. of Agriculture, 1890, pp. 38–41.

[b] Alwood, William B. Bitter-Rot. Bul. 17, Va. Agr. Exp. Sta., 1892, pp. 61–62 and 64–65. Also Ripe-Rot, or Bitter-Rot of Apple. Bul. 40, Va. Agr. Exp. Sta., 1894, pp. 59–82.

[c] Garman, H. Bul. 44, Ky. Agr. Exp. Sta., 1893, pp. 3–24.

[d] Stinson, John T. Bitter-Rot. Bul. 26, Ark. Agr. Exp. Sta., 1894, pp. 33–34.

[e] Whitten, J. C. The Bitter-Rot. Bul. 31, Mo. Agr. Exp. Sta., 1895, pp. 3–4 and 7–15.

[f] Quaintance, A. L. Bitter-Rot of Apples. Thirteenth Annual Report, Ga. Exp. Sta., pp. 360–361 and Pl. IX.

[g] Stinson, John T. Preliminary Report on Bitter-Rot or Ripe-Rot of Apples. Bul. 1, Mo. State Fruit Exp. Sta., pp 3–21.

[h] Stinson, John T. Notes on Spraying for Bitter-Rot. Bul. 2, Mo. State Fruit Exp. Sta., pp. 3–20.

[i] Bul. 77, Ill. Agr. Exp. Sta., p. 366.

Reporting upon two years' experiments, von Schrenk and Spaulding[b] state that "to a certain extent, varying from 10 to 75 per cent, Bordeaux mixture surely does prevent the ravages of the bitter-rot." They also strongly recommend the removal of diseased fruits, mummies, and limb cankers.

THE VIRGINIA EXPERIMENTS.

The orchard of Mr. W. H. Goodwin, in which the experiments were conducted, is situated on a spur of the Blue Ridge Mountains, in Nelson County, about 5 miles south of Afton. This and the adjacent county of Albemarle have long been famous for their production of the Yellow Newtown (or Albemarle Pippin) apples, some trees of which are 100 years old and still thriving. This variety is not subject to serious injury from apple scab, nor does it suffer materially from the leaf-spot diseases, and until the advent of bitter-rot magnificent crops were secured in this section without spraying.

Mr. Goodwin's orchard has a northern exposure, with an elevation of from 1,000 feet on the lower side to about 1,250 feet at the upper side. The land is very steep, having an incline of almost forty-five degrees in some places, and an extra man with a lever is required in spraying to prevent the wagon from upsetting. The soil is dark brown, almost black, deep, and fertile, such as is known throughout that section as "pippin" soil. The stones that almost completely covered the ground have been piled up in windrows, and a deep furrow has been plowed between the tree rows in which to run the upper wheels of the spray-wagon, to avoid turning over. Above the middle of the orchard is a spring with a flow of five to eight gallons a minute, which affords an ample supply of water for spraying purposes.

The bearing orchard is composed of about 800 trees of Yellow Newtown 18 to 23 years old, 500 Winesaps 8 to 23 years old, and 200 York Imperials 8 years old. There are also a number of young trees not yet in bearing. Mr. Goodwin states that the original forest was removed and the trees planted the second year after clearing, and that, as a rule, crops of corn or tobacco were grown between the rows until the trees came into bearing, or about twelve to fifteen years. Then the land was usually left uncultivated. A portion of it, including the experimental block, is now in sod, having been seeded to orchard grass in 1902.

---

[a] Burrill, T. J. Experiments in Spraying for Bitter-Rot. Trans. Ill. State Hort. Soc., 1902, 54–66.

[b] Bul. 44, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1903, pp. 38–45.

According to Mr. Goodwin, bitter-rot first appeared in this orchard to a noticeable extent in 1899, and in 1901 it did considerable damage. In 1903 the trees received three early applications of Bordeaux mixture, and on September 13 of that year the writer visited the orchard and roughly estimated the loss from bitter-rot at 40 per cent. When the crop was harvested, a few days later, Mr. Goodwin estimated the loss at about 60 per cent. Since 90 per cent of the crop was lost in some unsprayed orchards in the same neighborhood, it appeared that the treatment had some effect. In 1904 there was no crop.[a]

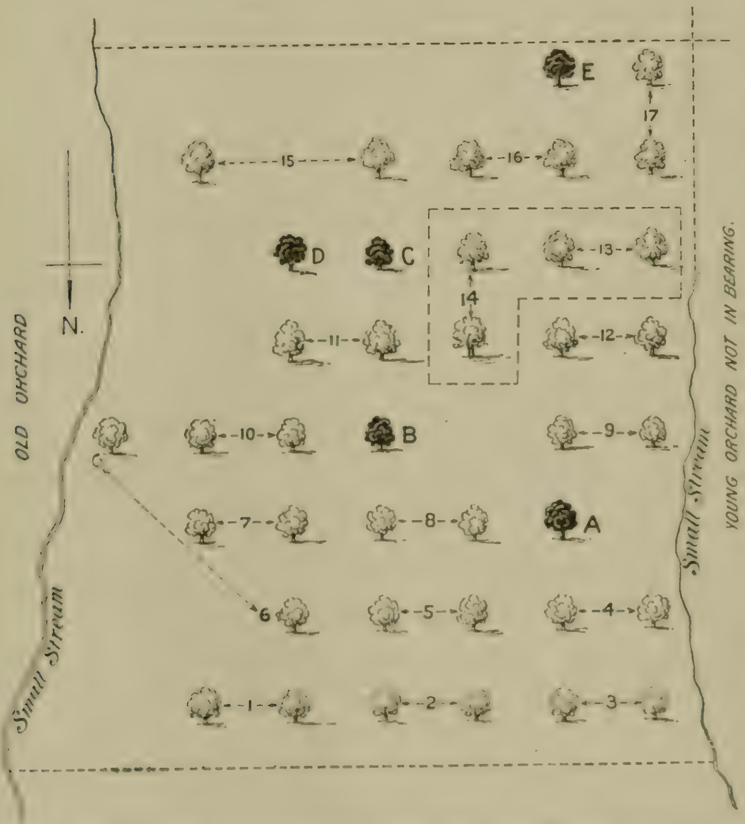


Fig. 1.—Plat of the block of trees used in the experiment.

THE EXPERIMENTAL TREES.

Only the Yellow Newtown variety was used in this experiment, the Winesap and York Imperial not being subject to serious loss from rot in this section. As may be seen from the accompanying plat (fig. 1), 35 trees were included in the experiment. They are 19 years old and about 25 feet high, with a spread of about 25 feet. These trees have been pruned by thinning out the conflicting branches, and have developed into the broad, low, somewhat pyramidal type naturally assumed by this variety. The block is situated below the middle of the orchard, with 23-year-old trees of the same variety on the east and a young orchard not yet in bearing on the west. Below (north side) is a block of young bearing trees of the same variety, the crop of which, not being properly sprayed, rotted badly. On the upper side is a block of young trees not yet in bearing.

---

[a] As a rule, apple trees in this section, especially the Yellow Newtown, bear only every other year.

THE PLAN OF THE EXPERIMENT.

Object.—This experiment was designed to determine (1) to what extent bitter-rot could be controlled by spraying with Bordeaux mixture, (2) the number of applications required, and (3) the proper time to make these applications. Owing to the influence of weather conditions upon this disease it was not expected that answers to all these questions could be obtained in a single season; but the season of 1905 was so favorable to bitter-rot, the disease appearing so early and continuing with such force throughout the season, that the results obtained are believed to be a safe guide for almost any season.

Spraying scheme.—In order to solve the questions just enumerated it was necessary to cover the entire season with a varying number of applications, using a process of elimination in the plan as shown in Table II (p. 23). As may be seen by reference to this table, the dates of the successive applications were as follows: April 8, May 1, May 9, June 12, June 27, July 10, July 25, August 7, August 22, and September 4. The first date was just after the cluster buds had opened, exposing the blossom buds, but before the latter had opened; the second just after the petals had fallen, and the third application eight days later. The fourth date was about six weeks after the petals had fallen, the subsequent dates being at intervals of about two weeks. The object of the first three applications was to combine the treatment of apple scab with that of bitter-rot and to determine their effect upon the latter. As shown in Table II, one group of plots (Nos. 1 to 5) receiving three to nine applications had one or more of the late sprayings omitted. From another group (Plots 9 to 12) the early applications for scab were omitted. Plots 15, 16, 17, and 12, receiving four applications each, were designed to determine the period at which spraying gives the best results. Plots 7 and 8 combine early and late spraying, leaving an early midseason interval that proved in this case to be too long. Plot 6 was sprayed just before the trees bloomed, as soon as the blossoms were shed, and eight days later (the usual apple-scab treatment), and every two weeks from June 12 to September 4, receiving ten applications in all. It was intended that Plot 9 should be sprayed at intervals of two weeks, beginning June 12, making the treatment for this plot the same as No. 6, with the three early applications omitted; but the writer inadvertently overlooked the first date. Therefore, in order to avoid duplicating No. 10, two more applications were dropped out of No. 9 later in the season. The original scheme included Plots 13 and 14, which were to have received the last three and the last two applications, respectively; but when the time arrived for their treatment to begin the crop on them was already destroyed by the rot and they were therefore dropped.

Each plot consisted of but two trees. There were, then, in the experimental block fifteen treated plots of two trees each and five untreated trees used as checks. By referring to the plat of the block (fig. 1) it will be seen that the checks (A, B, C, D, and E) were well scattered among the sprayed trees. Plot 1, at the lower left-hand corner, practically amounted to a check, as it received only the three early applications, and 62 per cent of the crop rotted. Check A is near the lower right-hand corner and B just below the center, while C and D are near the upper left-hand corner and E at the upper right-hand corner. Other trees were originally set aside as checks, but when it was found that bitter-rot was developing abundantly on all of them some were sprayed in order to reduce the loss to the owner. Two trees to the plot might seem at first thought insufficient for determining the best results from the spraying, but the trees are quite large, yielding about 20 to 35 bushels each. Moreover, the plots are almost in duplicate, there being a difference usually of only one application in adjacent plots.

WEATHER CONDITIONS ATTENDING THE EXPERIMENT.

Better conditions for a severe test of spraying could scarcely be desired. As will be seen from the following weather table[a], there was an abundance of rain throughout the season and considerable high temperature. Beginning June 16 it rained every day except one until June 25, and during that period the temperature ranged high, reaching 89° F. on the 18th, 94° F. on the 19th, 90° F. on the 20th, 89° F. on the 21st, and 92° F. on the 22d. This combination of moisture and heat made an ideal infection period. The conditions during July were also favorable to bitter-rot. It rained every day during the first week and continued at intervals throughout the month. The temperature reached 94° F. on July 18, and was 92° F. on the preceding and the following day. The orchard was frequently enveloped in fog and the dews were usually very heavy. As a consequence all unsprayed trees showed bitter-rot early in the month, and by the end of the month the disease was well under way. This ideal bitter-rot weather continued through August, and before the end of that month the crop on all unsprayed trees was practically destroyed. The crops in the unsprayed orchards in the neighborhood were also badly affected, showing that the outbreak of bitter-rot was general in that region.

---

[a] No exact meteorological data being available for the immediate vicinity in which the experiments were conducted, data are given for Charlottesville, Va., the nearest point where permanent records are kept, a distance of about 25 miles from the site of the orchard used for the experiment. The weather conditions appeared to be similar in the two sections, and the table may be considered fairly representative of the conditions that prevailed in the orchard. The data are from the monthly reports of the Virginia Section of the Climate and Crop Service of the Weather Bureau.

Table I.—*Daily maximum and minimum temperatures and precipitation at Charlottesville, Va., for June, July, and August, 1905.*

Day of month.	June.			July.			August.		
	Temperature.		Precipitation.	Temperature.		Precipitation.	Temperature.		Precipitation.
	Maximum.	Minimum.		Maximum.	Minimum.		Maximum.	Minimum.	
	° F.	*° F.*	*Inches.*	*° F.*	*° F.*	*Inches.*	*° F.*	*° F.*	*Inches.*
1	68	52	0.03	72	64	0.48	80	61	....
2	79	52	.04	87	63	.30	84	62	....
3	75	54	....	87	65	.05	84	64	....
4	81	55	....	89	66	2.70	83	....	0.02
5	89	67	....	82	66	.12	85	63	....
6	92	71	....	85	67	.33	91	67	....
7	80	60	1.69	85	64	.62	90	64	.75
8	71	60	....	87	70	....	76	66	.02
9	77	53	....	87	66	....	84	67	1.67
10	81	54	....	87	68	....	85	69	.53
11	83	63	Trace.	85	69	.19	87	68	.11
12	86	69	....	84	67	.82	88	71	.07
13	87	65	....	77	68	.16	89	67	.01
14	86	65	....	87	65	.63	82	66	.14
15	85	69	....	89	65	....	87	69	1.06
16	85	69	.18	87	68	....	85	69	....
17	86	69	.01	92	72	....	70	59	....
18	89	70	.05	94	74	....	76	58	....
19	94	67	.62	92	73	....	75	58	....
20	90	67	2.22	89	69	.70	82	59	....
21	89	66	.70	85	70	.27	87	65	....
22	92	69	....	77	64	2.64	89	66	....
23	83	69	.82	....	....	.01	88	66	....
24	76	65	1.60	86	62	....	88	63	.86
25	84	62	.04	80	63	....	77	64	.36
26	87	68	....	81	62	....	77	63	.07
27	74	61	....	81	61	....	74	59	....
28	88	57	....	74	64	.09	77	50	....
29	80	58	....	85	64	.03	87	56	....
30	82	62	....	84	61	....	89	70	....
31	....	....	....	77	65	....	83	71	....
Total	....	....	8.00	....	....	10.14	....	....	5.67
Mean	83.0	62.9	....	84.5	66.2	....	83.2	64.2	....

RESULTS.

The results, as indicated below, are due entirely to spraying, no effort having been made to check the rot by any other measure. No mummies or cankers were removed, and the apples that became infected were allowed to remain on the trees until the crop was picked or until they dropped. Those that fell to the ground were left under the trees until picking time. The hands that worked in the orchard were specially instructed not to remove any of the diseased apples from the experimental block. The object was to test the value of Bordeaux mixture under the most adverse conditions, and all possible sources of infection were left undisturbed.

On July 10, specimens of bitter-rot apples, some of which are shown in Plate I, could be found here and there in the orchard, especially on unsprayed trees, and two weeks later (July 24) each tree was examined by walking around it and looking for infected fruits. The diseased fruits were counted, and a general idea of the condition on that date may be conveyed by the following summary of the notes made at that time:

On each of the checks (A to E) 100 to 250 affected fruits were counted without climbing the trees, which probably means an infection of 10 to 15 per cent of the crop, since there must have been many diseased fruits unseen.

Plot 1 showed about 21 diseased fruits on each tree.

Plot 2 showed 5 diseased fruits on one tree and 6 on the other.

Plots 3, 4, and 5 showed 1 to 3 diseased fruits on each tree.

Plot 6 showed no rot.

Plots 7 and 8 showed 9 to 30 diseased fruits on each tree.

Plots 9 and 10 showed 7 to 18 diseased fruits on each tree.

Plot 11 showed 22 diseased fruits on one and 36 on the other tree.

Plot 12, which had not been sprayed, showed 112 diseased fruits on one and 150 on the other tree.

Plot 15 showed 25 affected fruits on one tree and 35 on the other.

Plot 16 showed 6 affected fruits on one tree and 10 on the other.

Plot 17 was apparently still free from bitter-rot.

The above is sufficient to indicate that in practically every tree there was an abundant supply of spores for a serious outbreak of the disease, and that wherever Bordeaux mixture was lacking the fungus became rampant.

It was almost impossible with the equipment used to spray the tops of most of the trees thoroughly, and later examinations showed that some bitter-rot occurred in the top of every tree. Every rain must have washed down an abundance of spores from diseased apples in the tops to fruits below.

In Table II the results from the two trees in each plot are combined, and the windfalls, both rotten and sound, are included. As a rule, half to three-fourths of the rotten fruit was on the ground at picking time. This was true of sprayed as well as unsprayed trees.

The crop of the experimental block was picked and sorted on September 19 to 23, inclusive, and the result from each tree kept separate. The fruit on the ground was picked up and classified into sound and rotten, and the fruit picked from the tree was likewise classified. Sound fruit constituted every apple free from bitter-rot, regardless of codling moth or scab. All fruits that were unmistakably affected with other rots, such as Sphæropsis, Penicillium, and Monilia, were discarded and not included in either class. As a rule, this did not exceed 3 per cent of the crop. Wherever there was any doubt, however, the trouble was charged to bitter-rot.

The final results of these experiments are shown in Table II, and it will be seen from this table that in every treated plot Bordeaux mixture had a beneficial effect regardless of the time of application, and that where the trees were properly sprayed the loss was less than 5 per cent of the crop, while the untreated trees suffered a total loss. It is rare that such results are obtained in the treatment of a plant disease. With the exception of leaf-curl of the peach, leaf-blight of the pear, and possibly apple scab, these results would indicate that bitter-rot yields more completely to treatment than any other disease known to the writer. The infection period of bitter-rot being much longer, a greater number of applications are required to secure protection throughout the season, but it would seem that an apple coated with Bordeaux mixture would not be attacked by bitter-rot even under conditions otherwise most favorable to the fungus.

TABLE II.—*Scheme of spraying at Avon, Va., during the season of 1905, and its results.*

Plot numbers (2 trees to each plot).	Treatment with Bordeaux mixture (5-5-50 formula).										Picked Sept. 19 to 23.		
	Apr. 8.	May 1.	May 9.	June 12.	June 27	July 10.	July 25.	Aug. 7.	Aug. 22.	Sept. 4.	Sound fruit.	Rotten fruit.	Percentage of sound fruit.
											Bushels.	*Bushels.*	
1	"	"	"	....	....	....	....	....	....	....	18.50	30.25	37.9
2	"	"	"	"	"	....	....	....	....	....	47.50	22.50	67.8
3	"	"	"	"	"	"	"	....	....	....	56.00	2.00	96.5
4	"	"	"	"	"	"	"	"	....	....	54.00	1.75	96.8
5	"	"	"	"	"	"	"	"	"	....	32.75	1.15	96.6
6	"	"	"	"	"	"	"	"	"	"	68.50	.70	98.9
A	Check—one untreated tree.										.00	10.00	[a]00.0
7	"	"	"	....	....	....	"	"	"	"	56.50	14.00	80.1
8	"	"	"	....	....	....	....	"	"	"	7.00	6.50	51.8
9	....	....	....	....	"	"	"	....	"	....	28.50	6.00	82.6
B	Check—one untreated tree.										.00	17.00	[a]00.0
10	....	....	....	....	"	"	"	"	"	"	59.00	6.50	90.0
11	....	....	....	....	....	"	"	"	"	"	42.25	6.50	86.6
12	....	....	....	....	....	....	"	"	"	"	28.50	24.75	53.5
C	Check—one untreated tree.										.00	13.00	00.0
D	Check—one untreated tree.										.00	20.75	[a]00.0
15	....	....	....	....	....	"	"	"	"	....	52.25	5.25	90.8
16	....	....	....	....	"	"	"	"	....	....	52.50	3.75	93.3
17	....	....	....	"	"	"	"	....	....	....	40.00	5.00	88.8
E	Check—one untreated tree.										.25	16.25	1.5

[a] Of the check trees, A had 1 sound apple, B 6, and D 2, but the percentages were too small to show in the table.

In the first column on the left of this table the numbers of the sprayed plots are given in figures and the unsprayed trees are indicated by letters. The dates of the applications are given at the heads of succeeding columns, and the ditto marks after each plot number refer to these dates. For example, the marks after Plot No. 1 indicate that this plot was sprayed April 8, May 1, and May 9; while Plot No. 12 was sprayed July 25, August 7 and 22, and September 4. The three columns on the right show the results in bushels of sound fruit, bushels of rotten fruit, and percentage of sound fruit for each plot, as determined when the crop was picked, September 19 to 23. The check plots are placed in the table about as they occurred in the orchard, Plot A being located near the lower side, while Plot E is at the upper side.

Plot 1, as will be seen from the table, received but three applications (those usually given in the treatment of apple scab), on April 8, May 1, and May 9, with the result that only 37.9 per cent of the fruit was saved from bitter-rot, showing that the treatment was stopped too early. (Pl. V, fig. 1.)

Plot 2 received, in addition to these three treatments, one on June 12, after an interval of 33 days, and a fifth application on June 27, with the result that 67.8 per cent of the crop was saved.

Plot 3 received, in addition to the foregoing treatments, one application on July 10 and another on July 25, making seven in all, with the result that 96.5 per cent of the crop was saved. (See Pl. III, fig. 1.)

Plot 4 received eight treatments, the dates being the same as in Plot 3, with an additional application on August 7. The percentage of sound fruit was 96.8.

Plot 5 received an additional treatment August 22, making nine applications in all, with the saving of 96.6 per cent of the crop.

Plot 6 was sprayed as in Plot 5, with an additional treatment on September 4, thus receiving an application on every spraying date, or a total of ten, the largest number given any plot in the experiment. The result was a saving of 98.9 per cent of the crop. (Pl. IV, fig. 1.)

Check A, which consisted of one untreated tree, yielded only one sound fruit and 10 bushels of rotten fruit. (Pl. III, fig. 2, and Pl. VII.)

Plot 7 received the first three applications, namely, on April 8, May 1, and May 9; and the last four, namely, on July 25, August 7, August 22, and September 4, leaving an interval of about two months and a half during which the trees were not sprayed. This interval was too long, as indicated by the yield of only 80.1 per cent of sound fruit.

Plot 8 was sprayed on the same dates as Plot 7, with the omission of the application on July 25, so that the interval during which the trees were not sprayed was about three months, resulting in a saving of only 51.7 per cent of the crop.

Plot 9 received applications 5, 6, 7, and 9, namely, on June 27, July 10, July 25, and August 22, 82.6 per cent of the crop being saved.

Check B, consisting of one untreated tree, yielded 17 bushels of rotten fruit and only six sound apples.

Plot 10 received applications 5 to 10, namely, on June 27, July 10, July 25, August 7, August 22, and September 4, 90 per cent of the fruit being saved.

Plot 11 differed from Plot 10 in that the treatment of June 27 was omitted. As a result of these five applications, 86.6 per cent of the crop was saved.

Plot 12 received one application less than Plot 11, the first treatment occurring July 25. Only 53.5 per cent of the crop was saved. (Pl. V, fig. 2.)

Check C, which consisted of one unsprayed tree, had 13 bushels of rotten fruit and no sound fruit, the entire crop having been destroyed.

Check D, one untreated tree, yielded 20¾ bushels of rotten fruit and only two sound apples. (Pl. IV, fig. 2.)

Plot 15 was sprayed on July 10, July 25, August 7, and August 22, and yielded 90.8 per cent of sound fruit.

Plot 16 received the same number of treatments as Plot 15, but the spraying was begun and ended two weeks earlier, the first application being made on June 27 and the last August 7. As a result 93.3 per cent of sound fruit was obtained. (Pl. VI, fig. 2.)

Plot 17 also received four applications at intervals of two weeks, but the treatment was begun two weeks earlier than in Plot 16, the spraying dates being June 12, June 27, July 10, and July 25. The yield of sound fruit was 88.8 per cent.

Check E, one untreated tree, yielded one-fourth bushel of sound fruit and 16¼ bushels of rotten fruit, the percentage of sound fruit being 1.5.

BENEFICIAL EFFECTS OF SPRAYING.

In analyzing the results as shown in Table II it is not difficult to conclude that in Plots 1 and 2 spraying was stopped too early, that in Plot 12 spraying was begun too late, and that in Plots 7 and 8 the interval between the early and late applications was too long. From Plots 3 to 6, as compared with Plots 1, 2, 7, 8, and 12, and the checks, it is also plainly evident that bitter-rot can be completely controlled by coating the fruit with Bordeaux mixture before infection takes place and keeping it thoroughly coated throughout the season. Moreover, Plots 10, 11, 15, 16, and 17 seem to indicate that, so far as bitter-rot is concerned, spraying before the trees bloom and within a month after the blooming period is not absolutely necessary. It is clearly seen by comparison, however, that the three early applications (April 8, May 1, and May 9) had a decidedly beneficial effect in all the plots that received them. Compare Plot 1, which received only these three applications and yielded 37.9 per cent of sound fruit, with the unsprayed trees, A to E, which yielded practically no sound fruit. Plot 12, which received four late applications (July 25, August 7, August 22, and September 4), gave only 53.5 per cent of sound fruit, while Plot 7, which had the same treatment and in addition the three early applications, gave 80.1 per cent of sound fruit. The three early applications thoroughly coated the branches and leaves, as well as the very young fruit, and it is probable that protection from infection was prolonged by the action of the rains in washing the copper from the leaves to the fruits. Of the several plots receiving only four applications each, No. 16, which received its first application on June 27, gave the best results, yielding 93.3 per cent of sound fruit. However, Plot 17, which had its first application two weeks earlier and yielded 88.8 per cent of sound fruit, would perhaps have shown up as well as No. 16 but for the fact that the upper side of one of the trees could not be properly reached with the spray. It appears, therefore, from this group of plots that the ideal treatment would have been five applications at intervals of two weeks, beginning June 12. Comparing Nos. 12 and 15, it is further noted that a delay of two weeks—from July 10, the date the first application was given No. 15, to July 25, the date treatment began on No. 12—made a difference of 37.3 per cent in favor of the earlier applications, representing the difference between success and failure.

Considering the series of Plots 2 to 8, which combine the three early applications for scab and the later applications for bitter-rot, No. 3 is the most satisfactory. This plot was sprayed seven times, namely, on April 8, May 1, and May 9 for scab, and on June 12, June 27, July 10, and July 25 for bitter-rot, and the result was 56 bushels of sound fruit and only 2 bushels of rotten fruit from the two trees, or 96.5 per cent of sound fruit. Plots 4, 5, and 6 each had a slightly larger percentage of sound fruit, but scarcely enough to pay for the additional spraying which they received. However, the bitter-rot fungus is so influenced by weather conditions that it is scarcely safe to follow No. 3 and stop spraying as early as July 25. The treatment (eight applications) given Plot 4 would doubtless be necessary in some seasons to prevent both scab and bitter-rot. The results obtained in Plots 15, 16, and 17 seem to indicate that four applications at intervals of two weeks, beginning June 12, June 27, or even as late as July 10, would be the most satisfactory treatment, when the cost of spraying is considered, but as a rule it pays to give three or four treatments earlier in the season for apple scab, leaf-spot, and codling moth, and, therefore, these early spring applications, combined with the early summer applications, undoubtedly give the most satisfactory results.

The lesson to be learned from Plots 7 and 8, as compared with Plot 6, is that the omission of the June and July applications is almost fatal to the crop. Comparing Plots 7 and 8, it is seen that the one extra application given to the former on July 25 resulted in a saving of 28.4 per cent over the latter. Again, comparing Plots 11 and 12, it is seen that one extra application given to the former on July 10 resulted in a saving of 33.1 per cent over the latter. These results emphasize the importance of spraying at the right time, and in order to be sure of covering the proper time the applications must be spread out over a long period.

EFFECT OF THE TREATMENT ON OTHER DISEASES.

Scab.—It is already well known that apple scab is easily controlled by spraying with Bordeaux mixture. This disease was completely prevented on the trees in the experimental plots receiving the three early applications, namely, first, just before the trees bloomed; second, as soon as the blossoms were shed, and third, eight days later. Some scab appeared on the trees not so treated, but this variety of apple

(Yellow Newtown) does not usually suffer from scab so much as some other varieties. The same treatment was given a block of Winesaps, with the result that the fruit at picking time showed practically no scab, while the three unsprayed trees left as checks had 80 per cent of the crop affected.

Leaf-spot.—The disease known as leaf-spot, which also yields readily to treatment, is very common in Virginia, causing considerable damage by defoliating the trees, and certain varieties of apples require treatment for this disease alone. Trees sprayed as early as June 12 held their foliage in fine condition until after the crop was harvested. The three early applications did not entirely prevent the leaf-spot disease, and the best results were obtained when the treatment was continued until July 25 or later. Winesaps that were sprayed as soon as the blossoms were shed, May 1, and at intervals of two weeks until three applications had been made, lost practically no foliage from leaf-spot. Also two trees sprayed on May 18, about three weeks after the blooming period, and on June 12 kept their foliage in perfect condition throughout the season. On the other hand three unsprayed Winesaps in the same orchard lost 50 to 75 per cent of their leaves by August 7, and most of those remaining on the trees at that date were affected. The unsprayed Yellow Newtowns, however, did not suffer half so much. The trees thus defoliated were not able to properly mature the fruit, which at picking time was perceptibly smaller than that of sprayed trees. In some cases the sprayed fruit was as much as one-fourth larger than that on the unsprayed trees.

Sooty-blotch.—Sooty-blotch also yielded very readily to treatment, the fruit on all the sprayed trees being clean, while a portion of the untreated fruit was more or less "clouded." The three early applications for scab appeared to be sufficient to control this fungus, though in severe cases two applications in July would no doubt be necessary to prevent the disease.

INJURIOUS EFFECTS OF THE TREATMENT.

Russeting.—The fruit on all of the trees that received the three early applications in the bitter-rot experiment on the Yellow Newtown apples developed russet spots or blotches due to the action of the copper. These blotches sometimes covered half of the apple, dwarfing the affected side. Usually, however, the spots were small and very irregular in shape, detracting little from the appearance of the apple. Fruits that did not receive these early sprayings were not affected, and the trouble seems to have resulted entirely from the two applications made to the young fruit on May 1 and 9. About 50 per cent of the fruit sprayed on these dates showed some russet spots, but the disfiguration was apparently not sufficient to affect its market value materially. When russeting is feared it might be advisable to use less bluestone and a greater quantity of lime in the preparation of

Bordeaux mixture for application to the very young fruit. The mixture used in spraying stone fruits (3 pounds of bluestone and 9 pounds of lime to 50 gallons of water) is suggested.

Coating of Bordeaux mixture.—The fruit from Plot 3, which received its last application on July 25, was practically free from Bordeaux mixture at picking time, September 19 to 23, the coating having weathered away. (Pl. III, fig. 1.)

The fruit from Plot 4, which received its last application on August 7, showed considerable Bordeaux mixture at picking time, but not sufficient to attract special notice.

The fruit from Plots 5 and 6, and, in fact, from all of the plots sprayed after August 7, was thoroughly coated with Bordeaux mixture at picking time. (See Pl. IV, fig. 1; Pl. V, fig. 2, and Pl. VI, fig. 2.)

The presence of Bordeaux mixture on the fruit when packed is certainly objectionable, but it was found that in picking, grading, and barreling the apples most of it was rubbed off. The crop from the sprayed trees, both in the experimental block and in Mr. Goodwin's main orchard, was sold at the highest price paid for Yellow Newtown apples in that section the past season, and the purchaser raised no objection to the coating of Bordeaux mixture and did not require the fruit to be wiped.

COMMERCIAL OPERATIONS.

The Bureau of Plant Industry furnished a number of its correspondents with suggestions for the treatment of bitter-rot, and during the past season the writer visited a few of the orchards that were sprayed in accordance with these suggestions, as well as others that had not been properly treated. In every case where Bordeaux mixture was applied at the proper time good results were secured. Even poor spraying had a decidedly beneficial effect. Owing to the steepness of the land or to some other obstacle, there were always some trees left untreated or but partially sprayed, thus affording ample checks with which to compare the treated trees. In most cases the results were very striking, showing almost a perfect crop on the sprayed trees and a loss of 75 to 100 per cent of the crop on the unsprayed trees. More striking still is the fact that where only one side of a tree was sprayed the crop on that side matured in perfect condition, while the crop on the opposite side was destroyed by bitter-rot. The writer observed this in a number of instances where a fence or a steep hillside admitted of the treatment of only one side of the trees.

RESULTS IN SEVERAL ORCHARDS.

Aside from the trees used in the experiment, Mr. W. H. Goodwin, of Avon, Va., sprayed the larger portion of his orchard under the directions of the Bureau of Plant Industry, and the writer was able to see the work in progress from time to time and to note the results.

The treatment consisted of eight applications of Bordeaux mixture, corresponding very closely to Plot 5 of the experiment, with the omission of the fourth application (June 12), and the results appeared to be equally as good as those obtained in that plot (96.6 per cent of sound fruit). The commercial spraying was done with the same outfit and the same men employed in the experimental work and usually began the day after that work was completed.

The results of this treatment are set forth very clearly in a letter from Mr. Goodwin to the writer under date of November 3, 1905, as follows:

> Replying to your favor of November 1, I have to say that in accordance with your directions I sprayed the major portion of my orchard of Albemarle Pippins eight times, beginning the applications on the following dates: April 9, May 2, May 10, June 28, July 11, July 26, August 10, and August 26. The portion of the orchard thus sprayed had practically no bitter-rot—perhaps not more than 2 per cent. On the other hand, the fruit on some 250 trees which could not be sprayed owing to steepness of land and lack of water was almost entirely lost from the bitter-rot. The crop on this portion of the orchard was estimated at about 800 barrels; but at picking time there were no No. 1's, and only 134 barrels of No. 2's (nearly all of which were more or less specked) were gathered.
>
> I am fully convinced that the bitter-rot may be almost entirely prevented by proper spraying with Bordeaux mixture, and in my opinion the establishment of this fact has reclaimed the pippin industry in Virginia. The last two crops were entirely lost from bitter-rot, whereas the crop the present year was saved by spraying. My trees are from 12 to 23 years old, and averaged about 3 barrels per tree. The trees were very thoroughly sprayed, costing for the eight applications about 30 cents per tree.

The orchard referred to was examined from time to time during the season, and on July 10 a few apples affected with bitter-rot were found, perhaps an average of less than one to each tree in the sprayed portion, and slightly more on unsprayed trees. By August 21, 75 per cent of the crop on most of the unsprayed trees was destroyed, and the fruit out of reach of the spray on the topmost branches of some of the tallest trees in the sprayed portion was badly affected, while all trees properly treated showed practically no rot. On a certain steep hillside the end tree in each row could be sprayed only on one side, resulting in a full crop of sound fruit on the sprayed half of the tree, while practically all of the fruit rotted on the other half.

Mr. William B. MacGregor, of Avon, Va., whose orchard is adjacent to the Goodwin orchard, sprayed his trees very thoroughly and persistently throughout the season, and was rewarded with a magnificent crop of almost perfect fruit. The writer had opportunities to visit this orchard while the spraying work was being done, and also at picking time. The course of treatment and summary of results are given in a letter from Mr. MacGregor, dated November 10, 1905, as follows:

> In reply to yours of October 31, I do not know the exact dates of spraying. In the part where the most spraying was done the first application was made about April 15, followed by others on May 7, June 1, and at intervals of from 13 to 17 days thereafter until September 1, making nine applications in all. Practically no rot appeared on this part. On trees not sprayed till June 1 the rot might be 3 per cent, but not more. On three trees not sprayed August 1, but which received all the other applications, no difference was noted. Applications must be thorough. Some of our trees had only a few apples, and to save time we tried to spray them only in July and August. Result, 25 per cent bitter-rot at least.

The orchard of Messrs. J. W. Rodes and Sons is located in the Rockfish Valley, about eighteen miles from Afton, Va. Mr. Rodes corresponded with the Bureau of Plant Industry concerning the treatment of the bitter-rot disease, and on July 26 the writer visited the orchard. The appearance of the trees indicated that they had been thoroughly sprayed with Bordeaux mixture, and on that date Mr. Rodes was spraying the tops of his tallest trees with an extra long extension rod, made by joining two rods of his outfit into one. He realized the importance of reaching every fruit with the mixture. With the exception of an occasional diseased fruit the sprayed portion of the crop throughout the orchard was free from bitter-rot. However, on one side of the orchard a fence interfered with the spraying, and about one-third of the crop on each of several trees could not be easily reached. In every such case the unsprayed section of the tree showed a serious outbreak of bitter-rot. A letter from Mr. S. T. Rodes, dated at Bryant, Va., November 3, 1905, and giving a statement of the treatment and the results obtained follows:

> Yours of October 31 to hand and contents noted. In reply will say we sprayed our orchard of 275 Albemarle Pippins six times for bitter-rot, starting on the dates given below and finishing as soon as possible. [Mr. Rodes then names the dates of commencing six successive sprayings, as follows: June 15, July 3, 15, and 31, August 17 and 30.]
>
> Where we could get at the trees and made the six applications there was no bitter-rot worth mentioning—scarcely any at all. Some trees that we could not spray on both sides on account of the fence showed quite a difference, the side sprayed having nice, clean apples, clear from cloud and rot, the fruit on the other side, unsprayed, being clouded and nearly all infested with the bitter-rot.
>
> Two years ago I believe the trees bore as many apples as they did this year. We did not spray them, however, and gathered only 56 barrels. From the same trees this year, but well sprayed inside and out, we gathered 1,142 barrels of No. 1 Pippins.

In unsprayed and poorly sprayed orchards in the Rockfish Valley bitter-rot was exceedingly bad, and there can be no doubt that the freedom from the disease in the sprayed orchards was due entirely to the treatment.

PREPARATION OF BORDEAUX MIXTURE.

The Bordeaux mixture used in the experiments was prepared according to the following formula:

5 pounds of copper sulphate (bluestone).
5 pounds of fresh stone lime.
50 gallons of water.

For small lots dissolve the bluestone in 25 gallons of water, and in a separate vessel slake the lime by sprinkling it with water until a thick paste is formed, and then dilute it to 25 gallons. Then pour the two solutions together through a strainer into the spray tank or other receptacle, a bucketful of each at the same time. When thoroughly stirred, the mixture is ready for application.

For extensive spraying, stock solutions should be prepared. Weigh out 50 pounds of bluestone into a coarse bag and suspend it in a 50-gallon barrel of water near the top. The bluestone thus suspended will usually dissolve within twenty-four hours, and the barrel should then be filled to the 50-gallon mark. Each gallon of this solution contains 1 pound of bluestone. Likewise 50 pounds of lime is placed in a barrel and slaked by slowly pouring water over it. While slaking keep it thoroughly stirred with a shovel, and continue to add water enough to keep it from burning, but the mass should not be submerged. When thoroughly slaked, dilute to 50 gallons. Each gallon will then contain the equivalent of 1 pound of lime, provided it is thoroughly agitated. Therefore, in order to make up 50 gallons of the mixture take 5 gallons of the bluestone solution and 5 gallons of the lime water. To prepare 200 gallons of the mixture for a spray tank of that capacity 20 gallons of each constituent would be required, but it should be remembered that these concentrated solutions should be diluted before pouring them together.

In order to save so much dipping, the mixing should be done on an elevated platform, such as shown in Plate VIII, figure 1. The platform shown in this illustration was constructed at the writer's suggestion by Mr. W. H. Goodwin for use in the bitter-rot experiments, as well as for his commercial work, and is about 2 feet higher than the top of the spray tank on the wagon. The stock solutions are kept in 50-gallon barrels on the rear of the platform, and the two dilution tanks, holding 100 gallons each, are placed at the front edge of the platform. The bluestone solution is placed in one of these tanks and the lime water in the other. Then each is filled with water up to the 50, 75, or 100 gallon mark, as desired. A molasses gate (or faucet) is fixed in a hole bored near the bottom of each tank, and this connects with an open trough leading to the strainer in the spray tank. Each of these gates is opened at the same time, and thus the two solutions are allowed to run together into the spray tank. In this case the water came from a spring about 100 yards above the platform, and was conducted into the barrels and tanks on the platform through open troughs. Where the convenience of an elevated spring is lacking, the water may be pumped up by hand, windmill, or engine.

METHOD OF APPLYING BORDEAUX MIXTURE.

The following account of the method of applying the Bordeaux mixture in the experiments of the Bureau of Plant Industry may perhaps serve as a guide to fruit growers in treating their orchards. One can not emphasize too strongly the necessity of reaching every part of the tree with the spray and coating the fruits on all sides.

The spraying was done with a specially constructed pump and a tank of 200 gallons capacity. The pump is fitted with two sections of ½-inch hose, each 25 feet long, with a 14-foot bamboo extension rod attached and double Vermorel nozzles. This outfit is seen in operation in Plate VIII, figure 2. When convenient two trees were sprayed at the same time, and the operators were thus kept out of each other's way. In spraying the tall trees the operator had to stand on the spray tank or climb the tree. Where the conditions will admit, an elevated platform built on top of the spray tank should be used for this purpose, but in the case here mentioned the land was too steep.

In making the first application great care was taken to coat the bark thoroughly from the ground to the tips of the twigs, but later applications were aimed at the fruit and foliage only. Nozzles with small apertures were used and the pressure was kept as high as one could maintain it with a hand pump. This produced a fine mist, and the attempt was made to spray the tree so thoroughly as to envelop every apple in this mist. So far as practicable, the trees were sprayed from every direction so as to hit every apple all over. When it could be avoided, the trees were not left dripping, the aim being to pepper the fruit and leaves thoroughly without producing drops large enough to run off. Good spraying does not consist in drenching the tree.

For extensive operations some form of power sprayer should be used where the conditions are suitable. Gasoline sprayers are perhaps the most promising, but in some instances they have been disappointing.

CONCLUSIONS AND RECOMMENDATIONS.

Summarizing the results obtained, and considering the fact that the experiments were made during a season unusually favorable to bitter-rot, the following conclusions may be drawn:

1. Bitter-rot can be completely controlled by proper applications of Bordeaux mixture, 93.3 to 98.9 per cent of sound fruit having been saved by such treatment in these experiments, while the checks rotted completely.

2. Four applications, when made just at the right time, are sufficient to control the disease satisfactorily, but in order to be sure of covering the infection periods one or two additional applications may be necessary.

3. The applications should be made at intervals of two weeks, beginning about six weeks after the trees bloom.

4. It is necessary to spray the trees thoroughly, coating the fruit on all sides with fine mist-like applications.

5. Other diseases, such as scab, leaf-spot, and sooty-blotch, may be controlled in connection with the treatment of bitter-rot.

For the treatment of bitter-rot alone, spray the trees thoroughly with Bordeaux mixture at intervals of two weeks until five applications have been made, beginning not later than forty days after the petals have fallen (in Virginia usually about June 10 to 15).

For the combined treatment of apple scab and bitter-rot, spray the trees with Bordeaux mixture (1) just before they bloom (but after the cluster buds have opened and exposed the flower buds); (2) as soon as the petals fall; (3) a week or ten days later; and (4) about forty to fifty days after the shedding of the petals, and at intervals of two weeks thereafter until, in all, seven or eight applications have been made.

It is true, of course, that the number of applications required and the dates on which they should be made depend to a considerable extent upon the season, but the treatment should always begin before the infection period, which may occur as early as forty to fifty days after the fruit has set (in Virginia, perhaps by the middle of June in some seasons).

In a dry or cool season the intervals between the later sprayings may be lengthened, thus reducing the number of applications required, provided the fruit is first thoroughly coated, which will necessitate at least two applications.

On the other hand, in a hot, humid season it will probably be necessary to shorten the intervals and increase the total number of applications.

Should, for any reason, the treatment be delayed until after it is discovered that infection has taken place, the trees should be thorougly sprayed twice in rapid succession with an interval of only a few days, in order to coat the fruit thoroughly as quickly as possible. With one application alone it is difficult to coat the fruits sufficiently to protect against bitter-rot, and the second application, which adheres better than the first on account of the presence of the previous coating and also reaches parts of the fruit not touched before, is necessary for thorough protection.

PLATES.

DESCRIPTION OF PLATES.

Plate I. (*Frontispiece.*) Three apples affected with bitter-rot and three mummies which presumably furnished the infection. The twigs with these fruits and mummies attached were cut from one of the unsprayed trees in the experimental orchard on July 10, and the photograph was made two days later.

Plate II. The microscopic characters of the bitter-rot fungus (*Glomerella rufomaculans* (Berk.) Spaulding & von Schrenk): *1.*—Five asci, each containing eight ascospores; also one probably immature ascus. × 900. *2.*—A group of free ascospores. × 900. *3.*—A group of ascospores germinating in a drop of water. × 900. *4.*—Spore-bearing hyphæ springing from a mycelium growing in nutrient agar: *a*, the mycelium giving rise to the fertile hyphæ; *b*, a group of conidia, or summer spores, newly born. × 600. *5.*—A group of germinating conidia. × 740. *6.*—A section through a pustule showing the ruptured skin of the apple, the spore-bearing hyphæ, and the free conidia. × 200.

Plate III. Fig. 1.—The crop picked from one tree of Plot 3, showing 33¼ bushels of sound fruit on the left and 1¾ bushels of rotten fruit on the right. Fig. 2.—Fruit from an untreated tree (Check A). The only sound apple from the tree is shown on top of the basket.

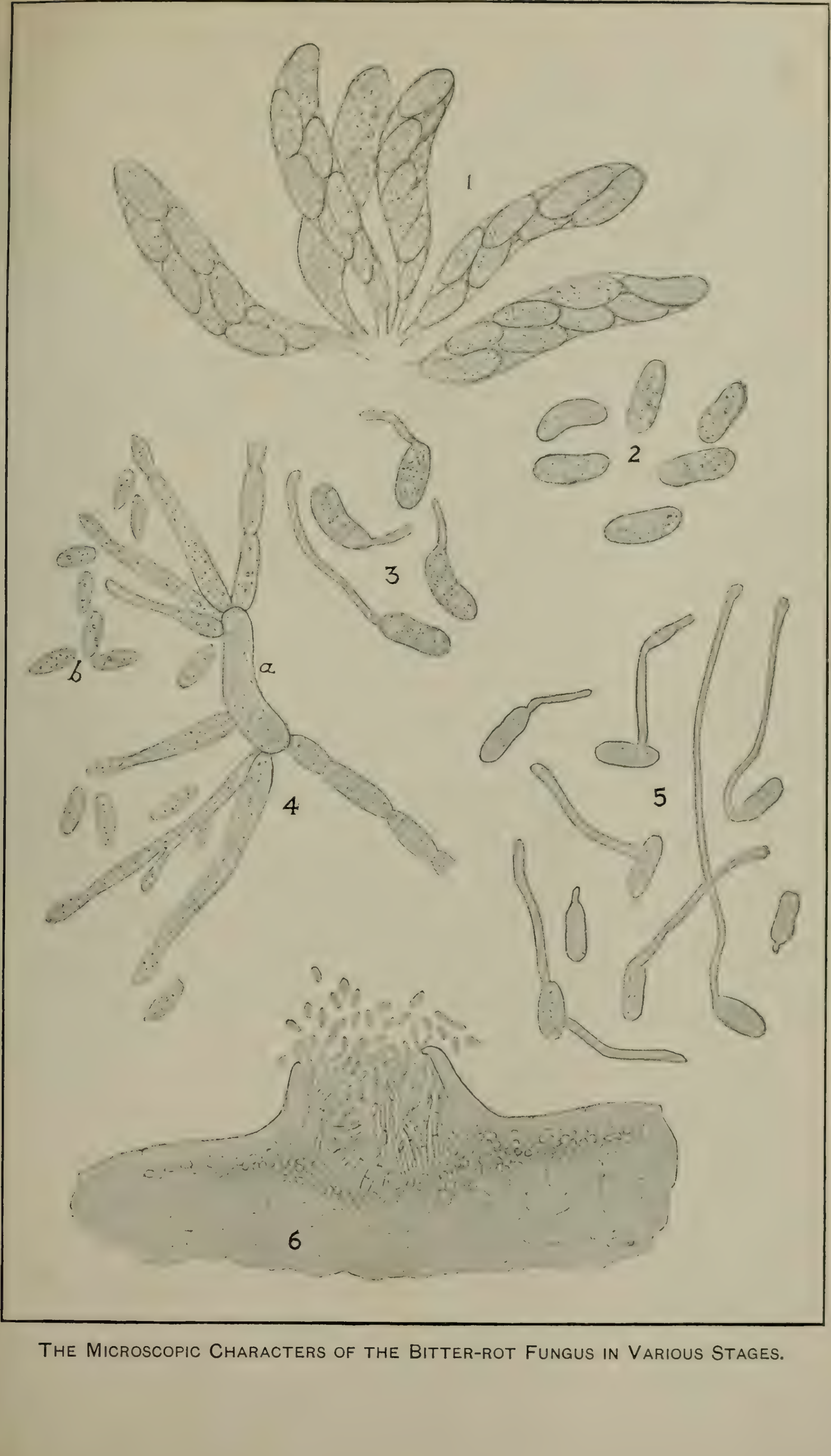
Plate IV. Fig. 1.—Crop picked from one of the trees in Plot 6, showing 39 bushels of sound fruit and less than a peck of rotten fruit in the half-bushel measure on top of the pile. The fruit still shows a coating of Bordeaux mixture. Fig. 2.—The crop from an unsprayed tree (Check D), showing only two sound apples, which are placed on a board on top of the heap of rotten fruit.

Plate V. Fig. 1.—Fruit from one of the trees in Plot 1, showing 13¼ bushels of bitter-rot apples on the right, and 10 bushels of sound apples on the left; treatment too early for best results. Fig. 2.—The fruit from Plot 12, showing 12 bushels of sound apples on the right, and 12¾ bushels of rotten fruit on the left: treatment too late to save the crop.

Plate VI. Fig. 1.—A yellow Newtown apple badly affected with bitter-rot, and another recently mummified by the fungus. The specimen designated *A* shows a typical case of bitter-rot on a Yellow Newtown apple. The fruit was taken from the tree in this condition. The apple marked *B* has been recently mummified by bitter-rot, the entire fruit having become involved in decay. Fig. 2.—Apples harvested from one tree in Plot 16, showing 28½ bushels of sound fruit above and to the left, and 1½ bushels of rotten fruit in and near the baskets.

Plate VII. An unsprayed tree (Check A) with most of its crop on the ground at picking time, illustrating the destructive work of the bitter-rot.

Plate VIII. Fig. 1.—The platform and equipment used in preparing Bordeaux mixture; also showing the spray tank receiving a supply of Bordeaux mixture. Fig. 2.—The spraying outfit in operation.



THE MICROSCOPIC CHARACTERS OF THE BITTER-ROT FUNGUS IN VARIOUS STAGES.

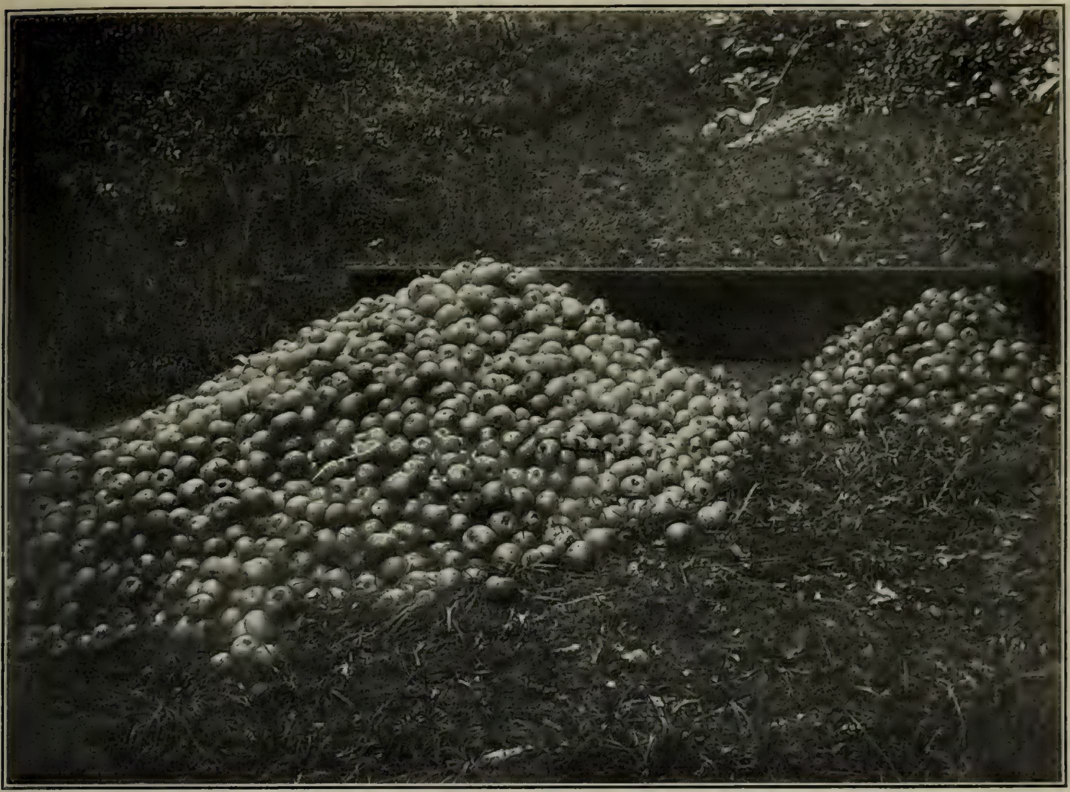


FIG. 1.—CROP OF APPLES FROM ONE TREE OF PLOT 3, SPRAYED SEVEN TIMES.

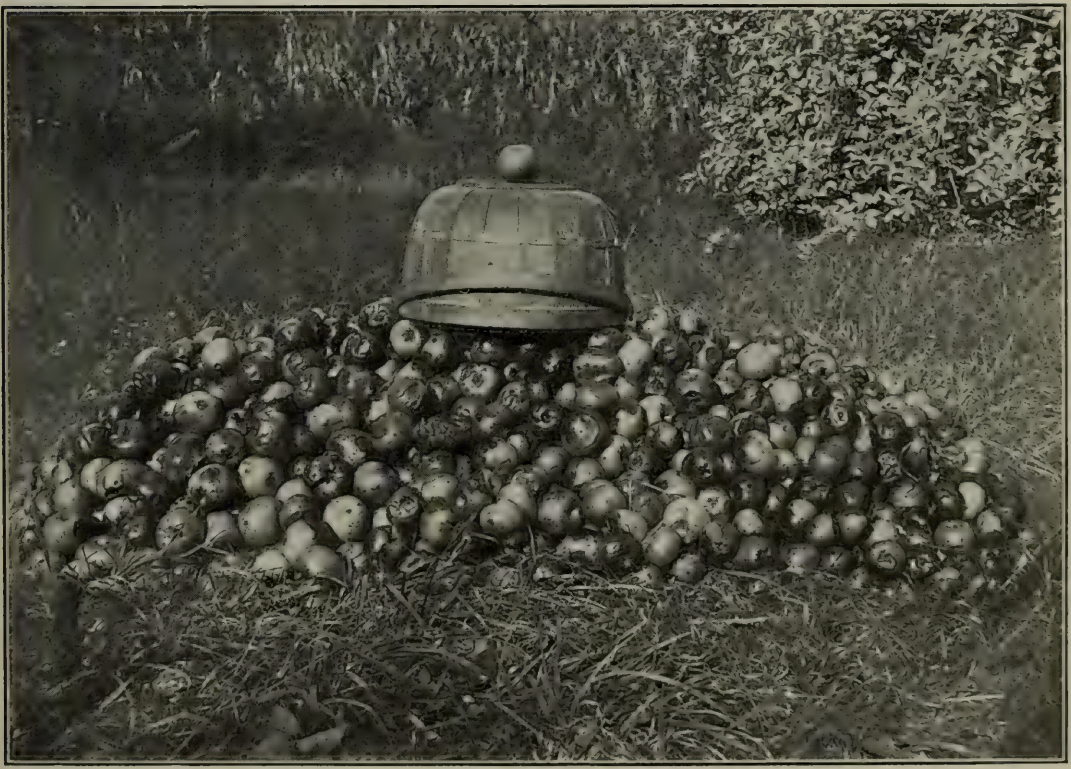


FIG. 2.—CROP FROM AN UNSPRAYED TREE (CHECK A).

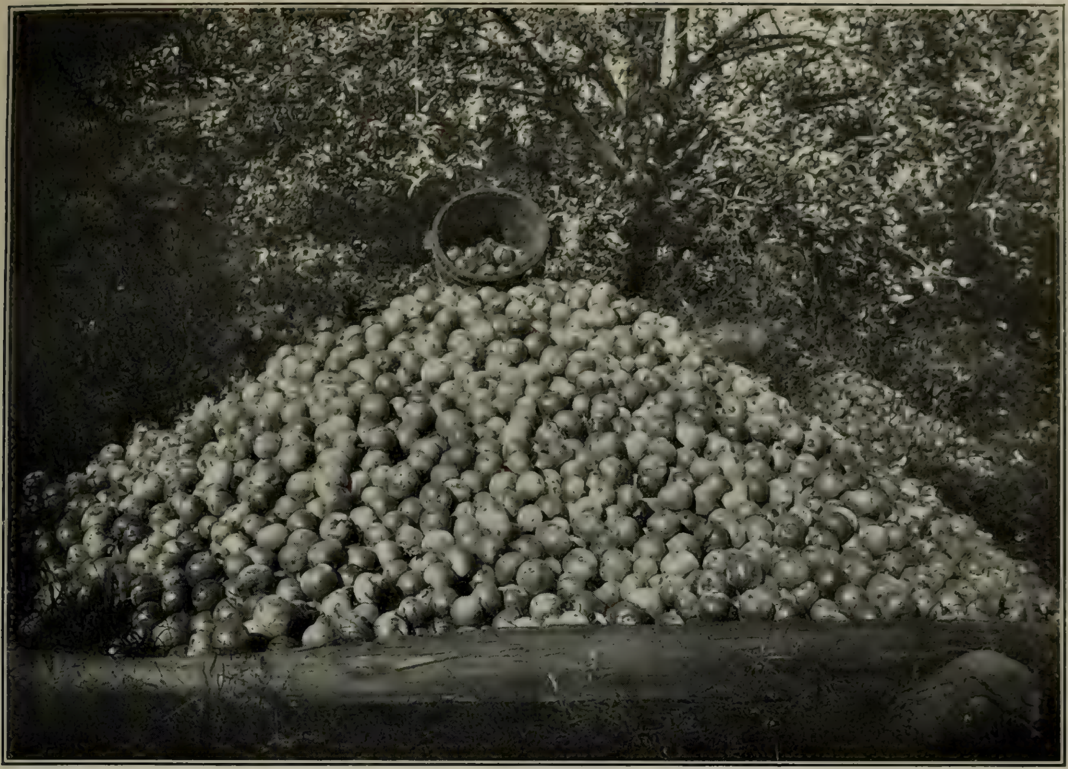


FIG. 1.—APPLES HARVESTED FROM ONE TREE OF PLOT 6, SPRAYED TEN TIMES.

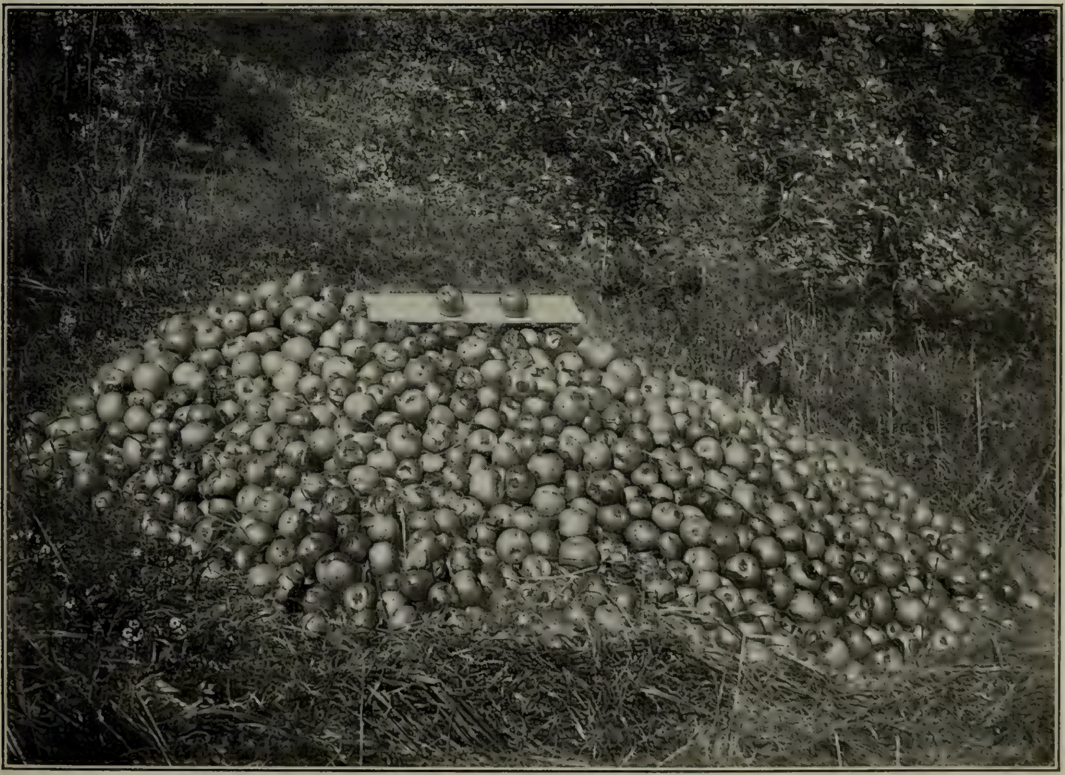


FIG. 2.—CROP FROM AN UNSPRAYED TREE (CHECK D).

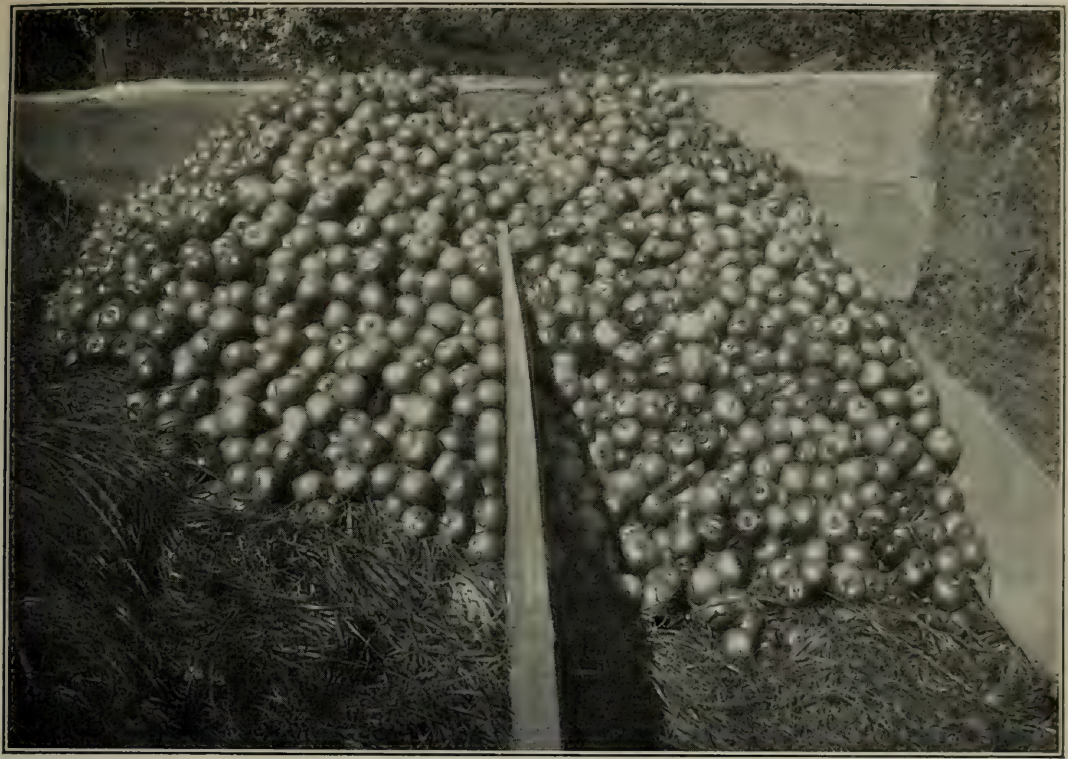


FIG. 1.—APPLES HARVESTED FROM ONE TREE OF PLOT 1, SPRAYED THREE TIMES; APPLICATIONS MADE TOO EARLY.

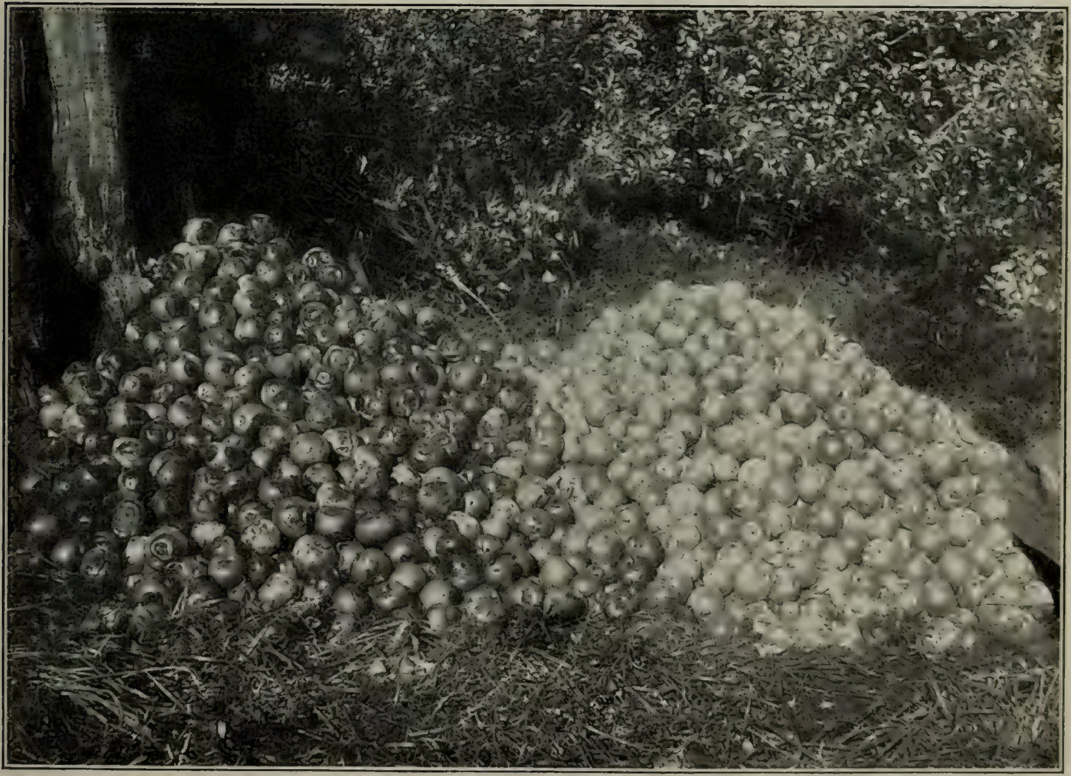


FIG. 2.—CROP OF APPLES FROM ONE TREE OF PLOT 12, SPRAYED FOUR TIMES; APPLICATIONS MADE TOO LATE.

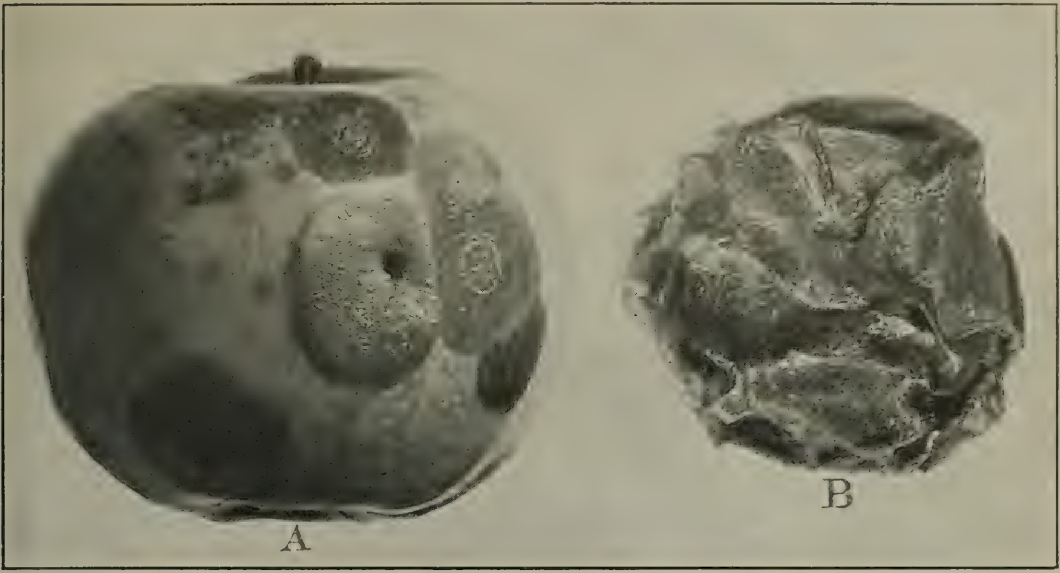


FIG. 1.—A YELLOW NEWTOWN APPLE (A) BADLY AFFECTED WITH BITTER-ROT, AND ANOTHER (B) RECENTLY MUMMIFIED BY THE FUNGUS.

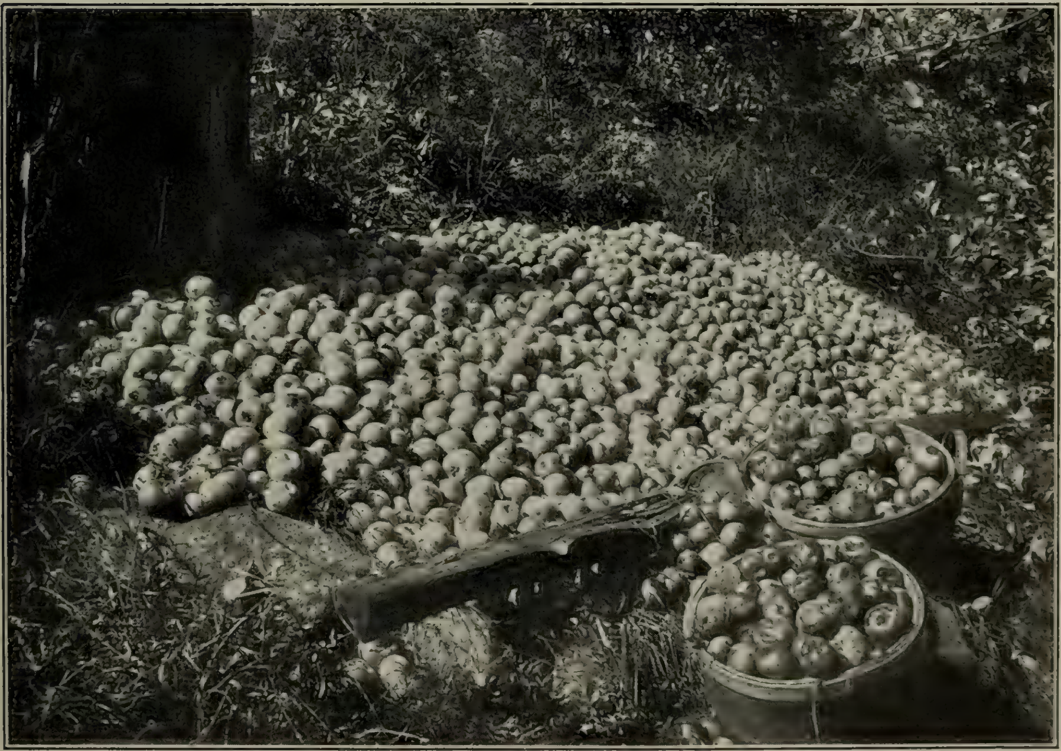
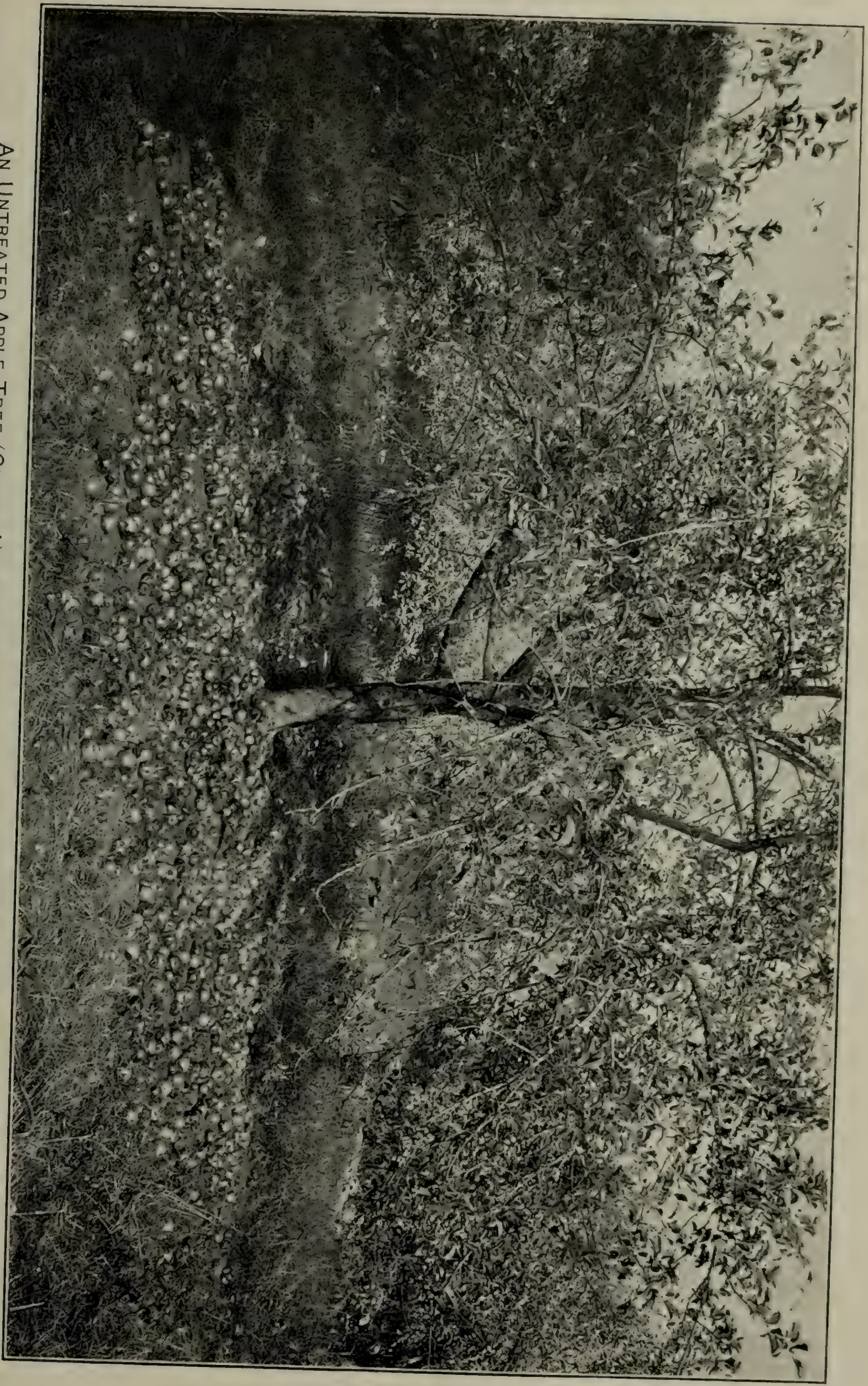


FIG. 2.—THE CROP FROM ONE TREE OF PLOT 16, SPRAYED FOUR TIMES AT THE RIGHT PERIOD.



An Untreated Apple Tree (Check A), with the Bulk of its Crop on the Ground at Picking Time.

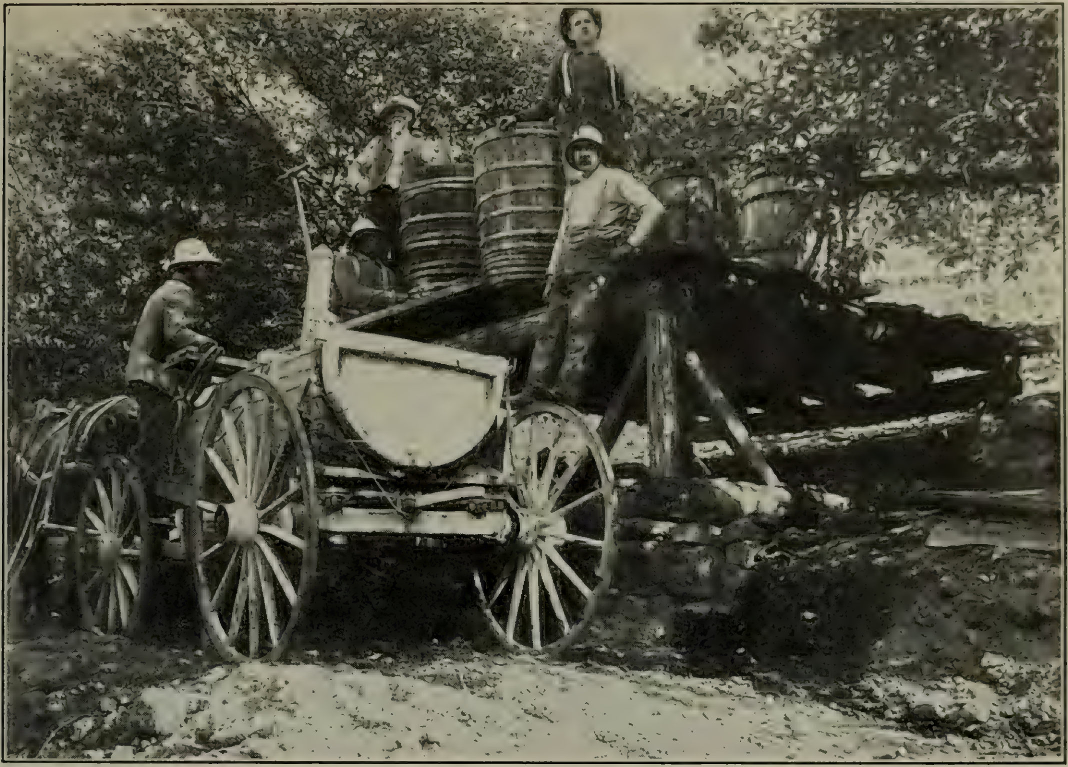


FIG. 1.—PLATFORM AND EQUIPMENT FOR MAKING BORDEAUX MIXTURE.

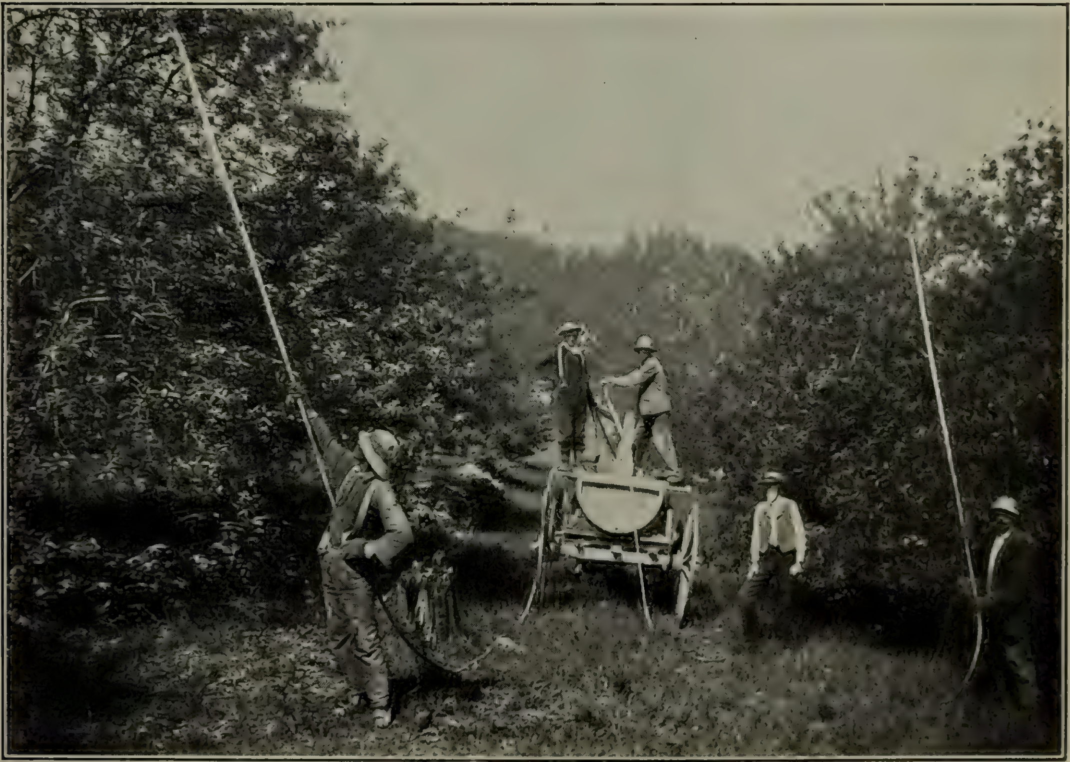


FIG. 2.—THE SPRAYING OUTFIT IN OPERATION.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 94.

B. T. GALLOWAY, *Chief of Bureau.*

FARM PRACTICE WITH FORAGE CROPS IN WESTERN OREGON AND WESTERN WASHINGTON.

BY

BYRON HUNTER,
Assistant Agriculturist, Farm Management Investigations.

Issued August 25, 1906.

239408
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

BUREAU OF PLANT INDUSTRY.

SCIENTIFIC STAFF.

Pathologist and Physiologist, and Chief of Bureau, Beverly T. Galloway.
Pathologist and Physiologist, and Assistant Chief of Bureau, Albert F. Woods.

PATHOLOGICAL INVESTIGATIONS.

Laboratory of Plant Pathology, Erwin F. Smith, Pathologist in Charge.
Diseases of Fruits, Merton B. Waite, Pathologist in Charge.

PHYSIOLOGICAL INVESTIGATIONS.

Plant Breeding, Herbert J. Webber, Physiologist in Charge.
Plant Life History, Walter T. Swingle, Physiologist in Charge.
Soil Bacteriology and Water Purification, Karl F. Kellerman, Physiologist in Charge.
Bionomic Investigations of Tropical and Subtropical Plants, Orator F. Cook, Bionomist in Charge.
Drug and Poisonous Plant Investigations and Tea Culture Investigations, Rodney H. True, Physiologist in Charge.
Physical Laboratory, Lyman J. Briggs, Physicist in Charge.

TAXONOMIC INVESTIGATIONS.

Economic Collections, Frederick V. Coville, Botanist in Charge.

AGRONOMIC INVESTIGATIONS.

Farm Management, William J. Spillman, Agriculturist in Charge.
Grain Investigations, Mark A. Carleton, Cerealist in Charge.
Arlington Experimental Farm, Lee C. Corbett, Horticulturist in Charge.
Sugar Beet Investigations, Charles O. Townsend, Pathologist in Charge.
Western Agricultural Extension, Carl S. Scofield, Agriculturist in Charge.
Dry Land Agriculture, E. Channing Chilcott, Expert in Charge.

HORTICULTURAL INVESTIGATIONS.

Pomological Collections, Gustavus B. Brackett, Pomologist in Charge.
Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge.
Experimental Gardens and Grounds, Edward M. Byrnes, Superintendent.

SEED AND PLANT INTRODUCTION INVESTIGATIONS.

Seed and Plant Introduction and Distribution, Adrian J. Pieters and David Fairchild, in Charge.
Seed Laboratory, Edgar Brown, Botanist in Charge.

SPECIAL LABORATORIES, GARDENS, AND FARMS.

Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge.
Subtropical Laboratory and Gardens, Miami, Fla., Ernst A. Bessey, Pathologist in Charge.
Plant Introduction Gardens, Chico, Cal., Palemon H. Dorsett, Pathologist in Charge.
Cotton Culture Farms, Seaman A. Knapp, Lake Charles, La., Special Agent in Charge.

Editor, J. E. Rockwell.
Chief Clerk, James E. Jones.

Farm Management Investigations.

W. J. Spillman, *Agriculturist in Charge.*

Scientific Staff.—F. G. Allison, Harmon Benton, D. A. Brodie, L. E. Carrier, J. S. Cates, J. S. Cotton, M. A. Crosby, L. G. Dodge, E. J. Glasson, David Griffiths, Byron Hunter, C. K. McClelland, H. B. McClure, R. A. Oakley, W. A. Peck, C. E. Quinn, S. M. Tracy, C. W. Warburton, J. A. Warren, J. M. Westgate.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 19, 1906.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 94 of the series of this Bureau, the accompanying manuscript, entitled "Farm Practice with Forage Crops in Western Oregon and Western Washington."

This paper was prepared by Mr. Byron Hunter, Assistant Agriculturist, under the direction of the Agriculturist in charge of Farm Management Investigations and in cooperation with the State agricultural experiment stations of Oregon and Washington. Provision has been made for publication by these two experiment stations.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

Page.

Introduction 7

Description of the region 8

Haymaking 9

  Conditions governing stage at which hay should be cut 9

  Curing hay 10

  Hay caps 11

The silo 11

The nature of leguminous plants 13

Forage crops 14

  Red clover 14

    Methods of sowing 15

    The seed crop 17

  Alsike clover 17

  Common vetch 18

    Methods of sowing 18

    Soiling 18

    The hay crop 19

    The seed crop 20

  Pearl vetch 22

  Field peas 22

  Alfalfa 23

    Methods of sowing 23

    Inoculation 24

  Timothy 25

  The rye-grasses 26

  Orchard grass 27

  Meadow fescue 27

  Velvet grass 28

  Indian corn 29

  Rape 30

    The seed crop 32

  Thousand-headed kale 33

    Methods of sowing 34

    Feeding 34

    The seed crop 35

  Root crops 35

  Soiling (green feeding) crops 38

Seeding timber burns and burnt slashings 39

ILLUSTRATIONS.

TEXT FIGURES.

Page.
FIG. 1. A common method of cutting tangled vetch 20
2. A field of thousand-headed kale on Martins Island, near Kalama, Wash 33
3. A "scuffle" hoe devised and used by W. J. Langdon, Sumner, Wash., in thinning and weeding root crops 36
4. A "scuffle" hoe similar in principle to that shown in figure 3, devised by A. B. Leckenby, Seattle, Wash 37

B. P. I.—215.

FARM PRACTICE WITH FORAGE CROPS IN WESTERN OREGON AND WESTERN WASHINGTON.

INTRODUCTION.

Although the average methods in farm practice in any region are usually far below the highest possibilities, men are to be found here and there who have worked out the problems of crop production and utilization in a satisfactory manner and who stand out as the most successful farmers in their respective communities. By studying the methods of a large number of such men it is possible to acquire a large amount of valuable information that would require years of patient labor to glean from personal experience. During the three years the writer has had charge of forage plant investigations in the Pacific Northwest, considerable time has been spent in the Willamette Valley and the region of Puget Sound studying the methods of the farmers most successful in growing and handling forage crops. In addition to the information obtained in this detailed study, much has been gleaned during thirty years' residence in the Pacific Northwest, including nine years' residence in the Willamette Valley. This bulletin is a result of this study, and the material herein contained, except as noted in the text, is based almost entirely upon the information obtained in this manner.

For the benefit of the readers of this bulletin not familiar with the condition under which the crops discussed are grown a brief description of the region is given. Although much has been published regarding the superiority of legumes over other plants as soil renovators and food for farm animals, there are many into whose hands this bulletin is likely to fall who do not understand the importance of this group of plants. For this reason a paragraph is given upon the nature of these plants and the methods of their inoculation. For similar reasons the principles underlying haymaking and the use of hay caps are discussed.

DESCRIPTION OF THE REGION.

What is said in these pages is applicable to all that region west of the Cascade Mountains in Oregon and Washington as far south as the upper portion of the Willamette Valley. With the exception of some of the mountainous areas the winters are mild. The summer months are comparatively dry, the nights are cool, and dews are frequent and heavy. The annual rainfall varies from about 20 inches in a small area where the Strait of San Juan de Fuca joins Puget Sound to more than 100 inches at several points along the Pacific coast. The main body of agricultural land about Puget Sound has an annual rainfall of 30 to 60 inches; that of the Willamette Valley 40 to 50 inches.

The average rainfall of this region for six years is shown in the following table:

Average monthly and annual rainfall at points in the States of Oregon and Washington.

Month.	Oregon.			Washington.		
	McMinnville.	Albany.	Salem.	Olympia.	Seattle.	Bellingham.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January	7.04	5.48	6.15	8.25	3.93	3.34
February	6.38	6.22	4.17	7.08	4.57	2.69
March	5.71	5.06	4.61	5.17	3.26	2.72
April	3.25	2.41	4.07	4.32	2.38	2.64
May	2.04	1.47	3.42	3.06	2.03	2.52
June	1.15	.74	1.47	2.09	1.87	2.02
July	.53	.57	.28	.55	.82	1.14
August	.81	.82	.65	.68	.68	1.43
September	1.97	1.85	1.94	2.91	2.13	2.26
October	3.39	2.29	3.62	4.24	3.05	2.51
November	10.13	7.44	8.18	10.98	5.77	4.93
December	4.47	6.17	6.62	7.92	5.13	3.85
Yearly	46.87	40.52	45.18	57.25	35.62	32.05

It will be seen that the rainfall is light during summer, heaviest during winter, and quite well distributed throughout the remainder of the year. With its mild winters and abundant rainfall the region as a whole is exceedingly well adapted to forage plant production. Grasses remain green during the entire year, while the clovers, vetches, root crops, rape, and kale, with proper care, all yield abundantly.

In Oregon the Willamette Valley constitutes the major portion of the agricultural land of the region studied. When first brought into cultivation the valley soil was friable, easily tilled, and productive. For years the cereals were practically the only crops grown, and much of the land at the present time is still producing these crops exclusively. The average yield of wheat on such land at the present time is said to be as low as 10 or 12 bushels per acre. Formerly it was much higher. The growing of cereal crops year after year has depleted the soil of much of its humus and rendered it heavy, lifeless, and difficult to work. Applications of barnyard manure and the growing of leguminous crops bring the soil back to its proper texture and fertility, and since dairying and live-stock production have become such important industries in the valley much of the land is being rapidly restored to its former productiveness.

Western Washington is largely covered with a dense growth of evergreen timber and underbrush. The prairie land is limited and much of it is gravelly and of little agricultural value. Most of the agricultural land was formerly timbered, and it has shown itself eminently adapted to the production of forage crops and various kinds of fruit. Clover has been one of the leading crops for years, and little of the land has been subjected to the exclusive production of cereal crops. As might be expected, therefore, most of the farm land of western Washington is still in a very productive condition.

HAYMAKING.

To make hay of prime quality west of the Cascade Mountains is often a difficult matter. Most of the hay crops, if allowed to mature naturally, are ready to cut during the month of June, while the late spring rains are usually not over until the 1st of July. Thus, haymaking would naturally occur at a time when good weather can not always be relied upon. Even when the weather is fair the nights are cool and dews are frequent and heavy. This difficulty is often partially overcome by pasturing the meadows in the spring until about the 1st of May to retard the development of the crop, so that haymaking will occur after the late spring rains are over.

CONDITIONS GOVERNING STAGE AT WHICH HAY SHOULD BE CUT.

There are several factors to be considered in determining the proper stage at which a crop should be cut for hay. Chemists tell us that hay made from young growing plants is more digestible and contains more protein per pound than hay made from more mature plants. If hay is cut early the percentage of protein is greater; if cut later, the percentage of protein is less, but the yield of dry matter in pounds is materially increased. As an illustration of this, see the table giving the amount of dry matter in corn at different stages of development, page 29. The protein content of hay made from the true grasses, such as timothy or orchard grass, is always low, and the gain in protein per pound from cutting such hay early is always more than counterbalanced by the loss in dry matter. On the other hand, hay made from some of the leguminous plants is said to be too rich for certain classes of animals. Men who have had considerable experience in feeding vetch and alfalfa hay generally agree in saying that either is too strong a feed for horses, especially if cut very green. For this reason hay made from leguminous crops is frequently cut much riper if for horses than when intended for other animals.

Laxative feeding stuffs are undesirable for horses, but not for cows. Green hay is laxative in character, while hay cut in a more mature condition has an opposite tendency. The stage at which hay should be cut, therefore, will depend upon the class of animals for which it is intended.

The number of times a meadow is to be cut during a season is another factor in the time for cutting hay that must not be overlooked. If there is to be but one cutting, the greatest yield will be secured by allowing the crop to become quite well matured before it is cut. When two cuttings are to be made, farmers who have tried the experiment find that the greatest yield is secured by cutting the first crop while it is still green and growing and before the dry season has begun. The ordinary hay plants are not inclined to continue their growth after the first cutting if allowed to stand until their seed is pretty well formed. A delay of only a few days in cutting the first crop of the season often seriously affects the growth of the second.

A statement of the time for cutting will be found under the special discussion of each crop.

CURING HAY.

> The best hay is made without rain and with the least possible amount of sunshine. If it were possible to cure hay in the shade, the quality would be much better. The curing of hay is a process of drying and of fermentation. Hot sun tends to stop fermentations which produce hay of good quality.[a]

From what is said above it is evident that hay should remain in the swath only until dry enough to be raked evenly into windrows; that most of the curing should take place in the cock rather than in the swath or windrow; and that, just as quickly as it is safe to do so, it should be placed in the stack or mow. With fair weather and hot sun, light crops may be raked soon after mowing, often in two or three hours. Heavier crops, especially when green, require more time. When the growth is heavy the swath is often packed so closely to the ground from its own weight and the pressure of the wheels of the mower that the use of the tedder is necessary to dry it out evenly.

West of the Cascade Mountains hay is generally put up in permanent cocks, where it remains for a week or ten days. If it is to remain in the field but a short time some farmers cure it quickly by first putting it into small, flat cocks. In about twenty-four hours these are turned over, allowed to air, and three or four of them are then made into one permanent cock. At what stage hay should be stacked is a question upon which there are many opinions. A common rule with many farmers is to stack when juice can not be twisted out of a wisp of hay taken from the middle of the cock.

---

[a] W. J. Spillman, in "Farm Grasses of the United States."

As stated, the common practice in this region is to let hay remain in the field for about a week; in fact, a very large majority of farmers think good hay can be made in no other way under the climatic conditions west of the Cascade Mountains. There are some successful men, however, who put up hay by what has been termed the "rapid process." With good haying weather the method is about as follows: The grass is cut in the afternoon. Being unwilted, the first night's dew does not injure it. If the crop is heavy the tedder is started the next morning as soon as the dew has dried off, and the hay is gone over as many times as possible during the day. Just before evening it is raked and cocked. The hay then stands in the field for two nights and a day and until the dew is off the second day. The cocks are then scattered and aired, especially the bottom portions of them, and the hay is hauled to the mow during the day. It thus requires three days from cutting to hauling. The hay is scattered evenly in the mow so that it may all settle alike and exclude as much air as possible, and is salted at the rate of 10 pounds per ton. At night the barn is tightly closed to keep out damp air.

HAY CAPS.

When the price of hay is high, it is quite probable that hay caps can be used profitably in making hay west of the Cascade Mountains. The use of caps would prevent the outside of the cocks from becoming too dry, and would thus add to the total weight of cured hay. The quality of the hay would be greatly improved, for it would be practically uniform throughout. The use of caps would also greatly increase the certainty of saving the crop. A farmer in Georgia has used hay caps for ten years. He thinks they materially increase both the quality and the quantity of his hay. Unfortunately there are at present no hay caps on the market. However, they may be made of light canvas or any strong cotton cloth in sizes to suit. Caps 4½ to 5 feet square, with pegs or weights attached to hold them in place when in use, ought to give satisfactory service. A coat of oil should be applied to one side of the cloth. The caps should always be dried after being used, for they will mold if piled up wet.

THE SILO.

That the silo should have a very general use in western Oregon and western Washington, not only for the preservation of corn but for many other crops as well, ought to be apparent from an understanding of the climatic conditions of the region. As previously stated, most of the hay crops are ready to cut during the month of

June, while spring rains frequently continue until about the 1st of July. (See table giving the distribution of rainfall on page 8.) It will thus be seen that haymaking ordinarily occurs at a time when good weather can not always be relied upon. If meadows are pastured during the spring to retard the development of the crop, so that haymaking will occur after the late spring rains are over, the yield of the second crop is usually much lighter, since its growth is confined entirely to the dry season. By the use of the silo, on the other hand, the first crop may be cut for ensilage early in June, even though the weather be unfavorable for haymaking. If cut at this time, while the plants are still growing vigorously, a good second crop will usually mature for hay early in August—the best haying season of the year. A light third crop can be used for pasture or cut for ensilage late in the fall. It is evident, therefore, that the use of the silo will practically insure the saving of the first crop, increase the total yield per acre, and cause the second crop to mature at a time when good haying weather can usually be relied upon.

That all kinds of ensilage should be finely cut may be desirable, but we must not get the idea that it is essential. For years ensilage of the finest quality has been made in western Oregon and western Washington out of whole clover and grass (timothy, English ryegrass, etc.). In making ensilage of this kind, however, there are two essentials—an air-tight silo and great care in filling it.

Farmers who use the silo as indicated above agree that the first crop of grass and clover should be cut for ensilage from the 1st to the 15th of June, for the earlier the first crop is cut the greater will be the yield of the second.

Difficulty is usually experienced in raking up freshly cut green grass with an ordinary hayrake. Some farmers avoid this difficulty by cutting with a self-raking reaper or a mower with a buncher attachment. These bunches are then thrown on a wagon by hand. Others cut with an ordinary mower and load from the swath with a hay loader. The heavy green grass often bends the teeth on the elevator bars of the loader. The teeth may be reenforced by nailing blocks of wood on the elevator bars just back of the teeth.

In filling the silo the material must be evenly spread and thoroughly tramped, so that all of the air possible will be excluded. If this is not done much of the ensilage will spoil. Two principal methods were found in use by farmers in filling silos. In the first the freshly cut grass is dropped directly into the silo with a hayfork. Two men in the silo spread the material and tramp it thoroughly, especially around the edges. The center of the silo where the loads from the fork fall requires but little tramping. The second method is to drop the material upon a platform at the top of the silo by means of hay slings or a hayfork. A man upon the platform throws the material into the silo, placing it as best he can. Another man spreads it evenly in the silo and tramps it thoroughly. This is perhaps the safest method, for there is less chance to slight the work. For a few days after the silo has been filled, the settling of the material will allow the addition of two or three loads each day, each load being thoroughly tramped when added. When the filling is completed the top is covered about 1 foot deep with marsh grass or other waste material that will pack closely and exclude the air. This is wetted thoroughly and tramped daily for several days, using about 2 barrels of water at each wetting. The writer has seen ensilage of excellent quality made from whole grass in this way. He has also seen ensilage made by dropping the material into the silo without spreading and tramping that was practically a total loss.

THE NATURE OF LEGUMINOUS PLANTS.

Plants that produce their seed in two-valved pods, such as peas, beans, vetch, and alfalfa, are called legumes. The value of this family of plants as soil renovators has long been recognized, but in just what way they are capable of restoring fertility to the soil has not been understood until recent years. If the roots of a leguminous plant be carefully removed from the soil little lumps, called nodules or tubercles, will usually be found upon them. These nodules vary in size with different legumes and may be found alone or in clusters. On the roots of red clover they are about twice as large as the seed of that plant. The nodules are caused by bacteria that are parasitic in the roots.

By the aid of the bacteria living in the nodules, leguminous plants are enabled to assimilate atmospheric nitrogen. Since nitrogen constitutes approximately four-fifths of the atmosphere this family of plants has an inexhaustible supply of this important plant-food element. Other plants can not assimilate the nitrogen of the atmosphere; they can obtain it only from decaying organic matter and from commercial fertilizers containing nitrogen. Chemical analyses show the tisues of leguminous plants to be very rich in nitrogen; hence the value of these plants when plowed under as green manure. The roots of a clover crop ordinarily contain more nitrogen than the whole crop removes from the soil. As these roots decay, the plant food in them becomes available for other plants. Nitrogen is usually the first element of plant food that needs renewing; hence the great value of leguminous plants as soil renovators.

Generally speaking, the nodules of each kind of legume are caused by certain kinds of bacteria. Thus there is one kind for alfalfa, another for red clover, another for common vetch, and so on. At any rate the nodule-forming bacteria of red clover, for example, have become so accustomed to that plant that they are of little or no value in forming nodules on the roots of most other legumes. If nodule-forming bacteria are not in the soil no nodules will be formed; the failure of leguminous crops is often due to this cause. These bacteria may be artificially supplied in two ways, namely, by means of pure cultures of the bacteria and by transferring soil from one field to another. For further information regarding these two methods, see page 24. See also Farmers' Bulletin No. 240, U. S. Department of Agriculture.

FORAGE CROPS.

In the pages that follow, only those crops are discussed that have an important place in the agriculture of the region. What is said regarding methods of seeding, culture, and feeding these crops is based almost entirely upon the farm practice of the region.

RED CLOVER.

Considering the region as a whole, red clover (*Trifolium pratense*) is easily the leading forage plant west of the Cascade Mountains. It thrives best on rich, well-drained upland soils. Many of the low lands that are too wet and cold for red clover become adapted to it when properly drained. If allowed to develop naturally, this crop matures for hay early in June. Rains are not infrequent at this season of the year, and it is a common practice to pasture red clover in the spring until about the first of May to retard the development of the crop, so that haymaking will occur during good weather. Red clover begins to grow in the early spring and, unless the soil is very poor and the summer very dry, remains green and furnishes excellent pasture until early in December.

Generally speaking, red clover reaches its highest development on the coast and the region about Puget Sound, where, under favorable conditions, it may be cut three times during the year. To give three crops it must be grown on rich lands and must not be pastured in the early spring. The first crop should be cut for hay or ensilage early in June, the second for hay in August, and the third for ensilage late in the fall. In the Willamette Valley difficulty is often experienced in getting red clover established, especially on land that has produced cereal crops exclusively for years. This difficulty is probably due to the methods of seeding, the dry summers, the poor texture of the soil, the lack of available nitrogen, and possibly the lack of nodule-forming bacteria. Red clover also frequently runs out in a short time. It is believed by farmers that this is due to the ravages of the clover root borer. In spite of these difficulties, however, red clover is one of the leading forage plants of the Willamette Valley. It is not unreasonable to assume that these hindrances to the growth of red clover are largely responsible for the important place that common vetch occupies in the agriculture of western Oregon.

In the Willamette Valley it is a common practice to apply land plaster to clover in the spring, during March and April. From 40 to 60 pounds per acre applied on the surface of the ground in the early spring are said to double the yield of both hay and seed. Land plaster has the same effect when applied to other leguminous crops in this region, but it is essential that it be applied early enough to receive an abundance of rain.

METHODS OF SOWING.

There are many methods in use for sowing red clover in western Oregon and western Washington, some of which are given below:

(1) *Clover with early-sown winter wheat.*—From 8 to 12 pounds of clover seed per acre are sown in the early fall with winter wheat on land that has been summer fallowed or from which an early cultivated crop has been removed. The seed is usually sown broadcast and covered with a harrow. If the clover fails to catch it can be sown again in the spring, about the 1st of March.

(2) *Clover with late-sown winter wheat.*—Early in the spring, about the 1st of March, when the ground is heaving slightly from alternate thawing and freezing, from 8 to 10 pounds of clover seed per acre are sown broadcast on late-sown winter wheat. If the ground is dry enough when the clover seed is sown it may be covered with a harrow.

(3) *Clover with spring oats or wheat.*—With this method a good seed bed is essential. The land should be plowed deep in the late fall or winter, and as soon as in good working condition in the spring it should be cultivated until it is in perfect tilth. If the soil is inclined to run together it may be necessary to replow in the spring. Instead of plowing in the fall or winter it may be done in the early spring and the seed bed prepared immediately. After drilling in a full crop of oats or wheat, from 10 to 12 pounds of clover seed per acre are sown and covered with a harrow. In western Washington this is the usual method, with the exception that either timothy, English rye-grass, or orchard grass is usually sown with the grain and clover. On wet land alsike clover often forms a part of the mixture.

(4) *Clover alone.*—When clover is sown alone in the spring the land is plowed early and worked down fine. About the 1st of May it is again thoroughly cultivated to kill weeds and prepare the seed bed. From 10 to 12 pounds of clover seed per acre are then sown

and covered by harrowing. The clover may be pastured during the first season, but should not be cropped too closely during the driest part of the summer. This is becoming quite a popular method in the Willamette Valley and very satisfactory stands are secured, but the use of the land is almost lost the first year.

Clover may be sown alone also in the late summer or early autumn. Although this method is seldom used it is probably one of the most satisfactory ways of sowing clover west of the Cascade Mountains. If sown with grain in the fall, clover does not make a crop the next year, but if sown alone in the late summer a full crop is secured the next summer. It is essential, however, that the seeding be done early, for if sown in the late fall it is liable to be winterkilled. Only crops, then, that can be removed early should precede clover sown in this way.

(5) *Clover with rape.*—Sowing clover with rape is a very successful and popular method with many farmers who are engaged in raising sheep and goats. With the land prepared as indicated for sowing clover alone in the spring, from 10 to 12 pounds of clover seed and from 2 to 4 pounds of rape seed per acre are sown broadcast about the 1st of May and covered with a harrow. If the ground is rough and cloddy, it should be finished with a roller. If this mixture is sown on a thoroughly pulverized and compact seed bed, the rape develops rapidly and furnishes excellent pasture for sheep, goats, calves, or swine in from six to eight weeks. The tramping of the animals while feeding during the summer, principally on the rape, forms a dust mulch on the surface of the ground. In this way soil moisture is retained for the use of the clover during the dry summer season. If a hay crop is desired the second season, the rape is killed by pasturing it closely with sheep during the late fall or winter. Sheep eat off the crowns of the plants close to the ground and the rape then dies. If the rape is not killed it will go to seed the next summer, and the stalks will give some trouble in the hay. If the clover is not cropped too closely the first summer, this method gives an excellent stand.

Failures occur frequently, especially in the Willamette Valley, when clover is sown by any one of the first three methods described. With rich, moist soil of good texture and with frequent rains during the summer these methods are usually successful. But with soils that are inclined to puddle and dry out quickly—soils that have produced grain crops exclusively for a number of years—they often give poor results. Under such conditions the grain shades the clover too much, and robs it of the moisture necessary to carry it through the first summer.

THE SEED CROP.

Since the first crop of clover is seldom used for seed it is cut for hay or ensilage about the 1st of June to enable the second crop to make a good growth before the dry season begins. Instead of cutting the first crop for hay or ensilage, clover is sometimes pastured until late in May, and the first crop is then used for seed. By mowing the first crop, however, the second one comes on more evenly than when the first is pastured.

When the heads of the seed crop are pretty well dried and are dark-brown in color the clover is cut with a self-raking reaper, or with a mower with a buncher attachment. Bunches of the size of an ordinary wheat bundle are dropped in rows. When the heads are dry enough to powder when rubbed in the hands five or six bunches are thrown together by hand or bunched with a hayrake in the morning when damp with dew. The thrashing is done when possible with a clover huller, and the clover is hauled to the machine in tight-bottomed racks in order that the shattered seed may not be lost.

ALSIKE CLOVER.

Alsike clover (*Trifolium hybridum*) has a much wider range of adaptability in western Oregon and western Washington than red clover. It thrives not only on soil adapted to the latter—upland clays and well-drained soils—but also on lowland clays, alluvial bottoms, and many soils too wet and cold to grow red clover. Its stems are much finer and more recumbent than those of red clover, and its leaves are not so numerous. The yield of the first crop is very satisfactory, but it is disposed to make but little growth after a crop has fully matured for hay. If cut early, however, it is said to make a very satisfactory second growth. A delay of only a few days in the time of cutting the first crop makes a very marked difference in the growth of the second.

Alsike clover makes a very good quality of hay and is well suited to sow with timothy, since these two crops mature at the same time. It is a perennial, stands grazing well, and seems to be much less susceptible to the attacks of the clover root borer than is red clover. Since alsike clover is so nearly the equal of red clover in nearly every way it should be given a thorough trial in all localities west of the Cascade Mountains where red clover may have failed.

From what has been said it is evident that alsike clover is eminently adapted for sowing on land that is too cold and wet for red clover, in mixtures for permanent pastures, and on forest burns and burnt slashings that are to be used for pasture for several years.

The seed of alsike clover is quite small and 5 or 6 pounds per acre will be found sufficient when it is sown alone. With this exception, all that has been said regarding the seeding of red clover applies equally well to alsike clover.

COMMON VETCH.

The common vetch (*Vicia sativa*) is perfectly adapted to conditions west of the Cascade Mountains in Oregon and Washington and thrives even on very poor soil. It has been grown in the Willamette Valley for many years, and is rapidly replacing red clover in many localities. It is an annual legume of great value as a nitrogen gatherer, as a green manure, and as a soiling, hay, and pasture plant. It is also a very valuable cover crop in orchards when sown in the early fall. It makes excellent ensilage, and dairy cattle prefer the hay to that of red clover. The yield of cured hay is from 1½ to 4 tons per acre. A seed crop yields from 15 to 30 bushels per acre, the yield depending quite largely upon the efficiency with which the seed is saved. A bushel of clean seed weighs a little more than 60 pounds.

METHODS OF SOWING.

Common vetch stands the winters admirably in western Oregon and western Washington, and is sown in the autumn from the last of August to the last of November. It is sown also in the early spring, but fall seeding usually gives the largest yields. The stems of this vetch are not strong, and heavy crops are inclined to flatten out on the ground. When in this fallen condition it soon begins to mold and is very difficult to harvest. To furnish support for it and keep it up off the ground a bushel of oats, wheat, or rye, and a bushel of vetch per acre are usually sown together. Oat hay, especially for dairy purposes, is usually preferred to that of wheat or rye, and for this reason oats are usually sown with vetch, winter oats being sown in the fall and spring oats in the spring. It is a common practice with vetch growers to sow winter oats and vetch broadcast in the early fall on land that has raised a spring crop and to cover the seed with a disk harrow. If the land is loose and easily worked, this method gives good results, but like most other crops vetch gives much better yields if sown on a well-prepared seed bed. If the ground is packed, or if the seeding is done in the spring, the land is usually plowed and a good seed bed prepared.

SOILING.

Sown with rye the last of August or early in September, common vetch should be ready for soiling, i. e., feeding green, from April 15 to May 1; sown with winter oats or wheat October 1, it should be ready about May 1; sown with winter oats or wheat in the late fall, it should be ready about June 1; sown with oats in February, it should be ready about June 15. When cut in the early spring for soiling a second crop may be cut or pastured, or the land may be plowed and planted to some other crop.

THE HAY CROP.

Since fall-sown vetch matures for hay in June and rains are not infrequent at this season of the year it is quite a common practice to pasture it in the early spring—March and April—to keep the growth from becoming so heavy that it will fall before it is cut and to retard its development so that haymaking will occur after the rains are over. If the crop is heavy and falls during bad weather it is best to make ensilage of it immediately.

When the seeds are just appearing in the first pods is usually considered the best time to cut vetch for hay. Some cut it earlier than this, while others allow the first seeds to become pretty well matured. If the crop is not too heavy it may be handled in the ordinary way, but it should be put into cocks before the leaves are dry enough to be broken off during the handling. When very heavy it falls more or less, and usually in some prevailing direction. When in this fallen condition the rear of the sickle bar of the mower is usually raised and the guards tilted down. Sometimes a man follows the mower with a strong pitchfork and when the vetch clogs he sticks the tines of the fork into the ground just behind the sickle bar and pulls the vetch loose.

Others cut vetch in but one direction, the opposite way from that in which it is leaning, driving the mower back idle each trip. Men with forks throw each swath out as it is cut, so that the mower can get through without the vetch clogging on the sickle bar. Another way is to cut a swath and with forks roll it on the uncut vetch; cut another swath and roll the two cut swaths on the uncut vetch; cut again and roll out the three cut swaths. This process forms windrows of three swaths each. (See fig. 1.)

With the vetch fallen in one prevailing direction, others cut one way only, driving the mower in such manner that the fallen vetch will point forward and away from the direction driven at an angle of about 45°. A little experience will enable one to determine the proper angle. When the cutting of a swath is finished the sickle bar is raised and the mower thrown out of gear and driven back on the swath just cut to mash it down and make a path for the shoe of the sickle bar with the wheel of the mower. With the rear of the sickle bar raised, the guards tilted down, the vetch lying in the direction indicated, and the last cut swath lapping up on the uncut vetch and mashed down by driving the empty mower back over it, the inner wheel of the mower, as the next swath is being cut, runs upon the swath just cut and holds it so that the shoe of the sickle bar slips over with little or no clogging. In this way the swath upon which the wheels of the mower are running is cut in two again and another clean swath is also cut at the same time. Cutting each swath in two twice makes the handling of the hay much easier. After being cut the hay may be cured and handled in the usual way.

THE SEED CROP.

It is very difficult to separate the seeds of wheat or rye from vetch seed, while those of oats and vetch can be separated reasonably well. For a seed crop that is intended for market, therefore, oats and vetch are usually sown together in the early fall—about a bushel of each per acre. In the spring they are usually pastured until April to keep the growth from becoming so rank that it will fall. The vetch then matures in July. The seed matures very unevenly; the pods burst open when overripe and exposed to the sun, and much of the seed may be lost in this way. The best seed is always produced in the lower pods and the seed crop is usually cut when these pods are turning brown and before they have begun to drop their seed.

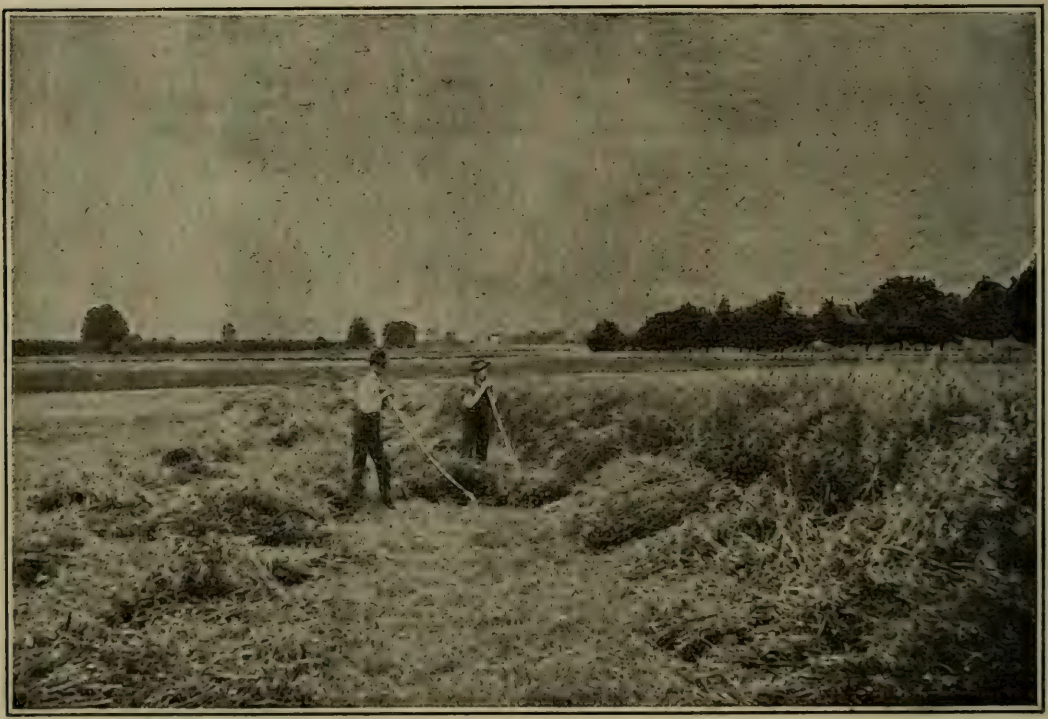


FIG. 1.—A common method of cutting tangled vetch. The first swath cut is rolled on the uncut vetch; after the mower passes again, the double swath is rolled on the uncut vetch; when the mower has cut under this, the triple swath is rolled outward.

If the crop stands up well and is not too heavy it is cut with a binder and shocked immediately. From 12 to 15 bundles are put in the bottom of the shock and other bundles built on top of this again, letting the butts of the upper bundles come down to the bands of the lower ones. Other bundles are built on top of this again, covering all of the seed pods possible. This prevents the shattering of a great deal of seed, for the pods dry evenly and gradually when not exposed to the sun.

If strictly pure seed is desired, vetch is sometimes sown alone at the rate of 100 to 120 pounds per acre. When thick it stands up reasonably well. If the seed crop is too heavy to bind, it is cut with a mower. With pitchforks the first cut swath is rolled on the uncut vetch; another swath is then cut and the two cut swaths rolled on the uncut vetch. When the third swath is cut the three cut swaths are rolled out. This forms windrows of three swaths each. It is then placed in large cocks immediately and allowed to dry with as little exposure to the sun as is possible. This method of cutting and cocking largely prevents the loss of seed from shattering. If cut and raked in the usual way the wheels of the mower, the wheels of the rake, and the tramping of the horses burst many of the ripe pods. As soon as the vetch is dry it should be thrashed without delay with an ordinary thrashing machine, hauling it to the machine in racks with tight bottoms or with canvas spread over the racks to catch the shattered seed. In thrashing, the concaves are removed and blanks having no teeth used instead. The motion of the cylinder is slowed down and plenty of wind turned on. The use of hay caps in curing vetch for seed would greatly increase the yield, especially when it is cut with a mower. The pods on the surface of the cocks become dry and burst before the centers of the cocks have time to cure. In this way a great deal of seed is lost. The caps would protect the pods on the surface of the cock from the direct rays of the sun and permit the whole cock to dry more evenly. (See the discussion of hay caps on p. 11.)

In growing a seed crop of vetch considerable seed is lost on the ground by the bursting of the pods. If this fallen vetch seed is plowed under, much of it will be covered too deeply to germinate. The amount of oil in the seed is such that it may then lie in the ground for years without decaying, and will grow when turned up near the surface by subsequent plowing. In this way it may become a pest in wheat that is grown for market. Land that has grown a seed crop of vetch may be prepared for wheat as follows: Sow oats and vetch broadcast in the fall, without plowing, and cover the seed with a disk harrow. Cut the oats and vetch for hay the next season and pasture the second growth close enough to prevent any seed from maturing. Grow a cultivated crop the next year. The land should then be ready for winter wheat.

PEARL VETCH.

Pearl vetch (*Vicia sativa alba*) has been grown in the Willamette Valley for a number of years, but is comparatively unknown except in the vicinity of New Era, Oreg. It is so much like the common vetch (*Vicia sativa*) that they can not be distinguished except by the color of the seed. The common vetch has a dark-colored, mottled seed, while the seed of pearl vetch is a light salmon color, with a pearly luster. The uses and values of these two plants seem to be identical. with the exception that the seed of pearl vetch, it is claimed, is a good table vegetable, being used particularly in making soup. Its seed probably also makes better feed when chopped. What has been said regarding the uses, culture, and handling of the common vetch applies equally well to pearl vetch.

FIELD PEAS.

Field peas (*Pisum arvense*) are well adapted to the conditions of western Oregon and western Washington. They do well on a large variety of soils, but are especially adapted to clay soils and alluvial bottoms. They are grown for grain, hay, ensilage, and soiling. Peas are nutritious, and the hay and ensilage are eaten with relish by most kinds of stock. When grown for hay about 2 bushels of peas and 2 bushels of oats per acre are sown together as early in the spring as the condition of the ground will permit. When sown at the same time the oats often choke out the peas. This may be largely avoided by sowing the peas first, preferably with a drill, since the seed is difficult to cover, and when they have sprouts on them about 2 inches long drill in the oats. This will give the peas the start and they will hold their own much better. If sown broadcast they should be well covered with a disk harrow. Peas should be cut for hay when the seeds in the first pods are just ready for table use. Sown in the early spring they mature for hay from the 1st to the 15th of July. The yield is from 1½ to 4 tons of hay per acre. When harvested for seed the yield is usually from 25 to 30 bushels per acre. Peas are often sown alone and harvested when mature by swine turned into the field.

The pea weevil often does considerable damage to the pea crop, especially when grown for seed. When sown late, peas suffer much more from the ravages of this pest than they do when sown early. Since they stand considerable frost they should be sown as early in the spring as the season will permit. Of late years peas fail in some localities from other causes than the weevil. They assume a pale, sickly appearance and the yield and quality of the hay are very unsatisfactory. In localities where this happens common vetch and pearl vetch should be grown instead of peas, for they are sure crops and are equal or even superior to peas in practically every way as a forage plant.

ALFALFA.

At the present time the growing of alfalfa (*Medicago sativa*) west of the Cascade Mountains is only in the experimental stage. Small areas are to be found in various places, some of which are doing reasonably well. Most of these have not been planted long enough and have not been studied sufficiently to justify definite conclusions as to the future usefulness of alfalfa in this region. There are many localities with well-drained soils, however, in which it will unquestionably succeed if given proper treatment. In regions in which the rainfall is as great as it is at certain seasons west of the Cascade Mountains, alfalfa requires a loose, permeable subsoil, and seems to thrive best on the sandy loams along the water courses. The best alfalfa fields noticed were on the sandy alluvial soils on the Willamette and Columbia rivers. The water table of land selected for alfalfa should be at least 4 feet below the surface, and the land should not be subject to overflow. Alfalfa will stand considerable flooding, provided the water is running, but it is usually destroyed if stationary water covers it for a few days.

There are two important difficulties to be overcome in the successful production of alfalfa in this region. In the first place bluegrass, English rye-grass, Italian rye-grass, velvet grass, couch-grass, and many other grasses and weeds have a strong tendency to crowd out the alfalfa. This difficulty is largely overcome by eradicating these plants, so far as possible, before the seeding is done. Thorough disking and harrowing at a time when the alfalfa has made but little growth, or just after cutting a crop of hay, tends to keep it vigorous and holds the weeds and grasses in check. The disk harrow should be weighted to make it cut deep and should be set about as straight as possible, so as not to cut off the crowns of the alfalfa plants. Although these grasses, when growing with alfalfa, actually decrease the total amount of forage produced, they also decrease the danger of bloating when the field is pastured by sheep, goats, or cattle. In fact, grasses are frequently sown with alfalfa for this purpose. Secondly, the first and last crops of alfalfa mature at seasons of the year when it is very difficult to make hay on account of the damp weather. This objection is obviated by using the first and third cuttings for ensilage, soiling, or pasture.

METHODS OF SOWING.

This must be governed largely by local conditions. Land that is naturally well drained or that is tiled at least 3 feet deep should be selected for this crop. If barnyard manure is available, put on from 15 to 20 tons per acre in the fall and plow it under 8 to 10 inches deep. In the spring, when the land is in good working condition, cut it up thoroughly with a disk harrow and work it down fine. Let it lie for a week or ten days; then give a good harrowing so as to destroy all weeds. Sow about 15 pounds of clean seed per acre and cover with a harrow. If the soil is inclined to be dry, finish with a roller. About the time the seed is sown, put on 75 to 100 pounds of land plaster to the acre.[a]

INOCULATION.

The failure of alfalfa west of the Cascade Mountains is frequently due to the lack of nodule-forming bacteria in the soil. If the land to be sown has never grown alfalfa before, it is the safest plan to artificially introduce these organisms. This may be done in two ways:

(1) From 300 to 500 pounds of soil, the more the better, may be hauled from a field that has recently produced alfalfa with nodules on the roots, and scattered evenly over the surface of the new field. This should be done just before the alfalfa seed is sown and the soil should be thoroughly mixed with that of the new field by harrowing or disking. It is quite expensive to inoculate large fields in this way and there is always a possibility of transferring plant diseases from one field to another.

Of scarcely less importance is the danger of disseminating noxious weeds and insect pests through this plan of inoculating by means of natural soils. Even though weeds may not have been serious in the first field, the great number of dormant seeds requiring but a slight change in surroundings to produce germination is always a menace. If soil is to be used, however, whether obtained from near-by fields or shipped long distances, the evidence should be clear that the soil is free from the objections mentioned above.[b]

(2) Pure cultures of the proper bacteria may be used. The Bureau of Plant Industry of the United States Department of Agriculture has isolated the different organisms for the different legumes, is growing them in pure cultures, and furnishes them to farmers whose soil conditions seem to indicate that inoculation is necessary.

Those desiring inoculating material should write to Soil Bacteriology Investigations, Bureau of Plant Industry, Washington, D. C., for an application blank. To avoid delays, requests should be on file several weeks before the material is to be used.

Should weeds tend to crowd out the alfalfa during the first year, they should be mown often enough to hold them in check. The cutter bar of the mower should be set about 5 inches high in order that the young alfalfa plants may not be cut too closely. If the crop mowed would be sufficient when dry to make a third of a ton or more of hay (and dried weeds) to the acre, which it usually will be in spots, it should be removed from the field; if less than this it may be permitted to lie where it is cut.

---

[a] Dr. James Withycombe, in Bulletin 76, Oregon Experiment Station.

[b] Farmers' Bulletin No. 240, U. S. Dept. of Agriculture.

The leaves and stems of alfalfa sometimes turn yellow, and the crop then assumes a very unthrifty appearance. When this condition begins to manifest itself the field should be cut immediately, even though the growth be very small. This will tend to invigorate the plants and keep them in a growing condition. If the growth is sufficient the first season, it may be used for either hay or pasture, but under no circumstances should it be closely pastured the first year.

In the moist climate west of the Cascade Mountains it frequently happens that alfalfa sends up young shoots from the crown of the plants before the first growth begins to bloom. When this occurs it should be cut at once; otherwise the first crop soon begins to deteriorate and the second growth will be seriously stunted. In this region it is very essential, therefore, to watch alfalfa closely and cut it as soon as these young shoots begin to appear.

Alfalfa is not a satisfactory pasture crop for cattle or sheep because of its tendency to produce bloat in these animals when they are allowed to graze on it, but for horses and hogs, particularly hogs, there is no better pasture.

TIMOTHY.

Timothy (*Phleum pratense*) is the standard grass in Oregon and Washington west of the Cascade Mountains. It is shallow rooted and naturally adapted to moist lands. But the abundant rainfall of this region, distributed as it is through so many months of the year, makes it possible for it to succeed on practically all classes of soils except the sands and gravels. There are individual farmers who like other grasses better, but timothy is the one grass that is universally known and grown. It has been the standard market hay so long and has so many valuable characteristics that it will require years for any other grass, even with superior qualities, to become as popular as timothy in this region.

There are many reasons why timothy enjoys this popularity. It has the best seed habits of any of our cultivated grasses. The seed is usually cheap, has a very high percentage of germination when properly matured, is easily harvested, and retains its vitality remarkably well. The hay is easily cured, stands handling well, and is relished by all kinds of stock. Unlike many other grasses, a few days' delay in the time of cutting makes but little difference in the quality of the hay—a very important point in a region where showers are not infrequent during the haying season.

West of the Cascade Mountains timothy is most frequently grown with red clover. It is sometimes sown in the fall with winter wheat and the clover added in the spring, during February or March, when the ground is thawing and freezing. Another method is to prepare the ground in the spring and sow the timothy and clover with or without a nurse crop. Still another way is to sow the clover in the spring with a nurse crop and in September, after the grain has been harvested, sow the timothy on the stubble. When sown with a nurse crop, timothy and clover are shaded too much, especially if the nurse crop is allowed to mature for grain, and unsatisfactory stands are often obtained in this way. Perhaps the most satisfactory way of sowing both timothy and clover is to sow them without a nurse crop in the late summer or early fall on land that is as free as possible from weeds. Good stands are secured in this way, and they give excellent yields the first year. Timothy is two or three weeks later than red clover, and when they are grown together for hay either the timothy must be cut a little immature or the clover allowed to become too ripe. For this reason some other grasses are better suited than timothy for sowing with red clover. When sown alone from 6 to 10 pounds of timothy seed per acre are sufficient. For a seed crop timothy yields much better when the stand is comparatively thin. A much finer quality of hay is produced when it is thick. It is the general rule to cut timothy for hay just at the end of the blooming period. Cattle prefer the hay when cut at this stage, while horses seem to relish it better if it is a little more mature.

THE RYE-GRASSES.

English rye-grass (*Lolium perenne*) and Italian rye-grass (*Lolium italicum*) are more popular on the Pacific coast west of the Cascade Mountains than in any other part of the United States. The moist, mild climate of this region is well adapted to their growth, and they are very popular with the comparatively few farmers who grow them. Stock seem to prefer them to all other grasses, and the herbage they produce is certainly of a very fine quality. The rye-grasses form a close sod and stand cropping and tramping well, but they do not yield so well as some other grasses. They mature early and are well suited to sow with red clover. They are especially adapted to low, moist soils, and when grown under favorable circumstances they may be cut two or three times during a season. Italian rye-grass is practically an annual. The plants do not all die at the end of the first year, but they amount to but little after the first season. Although usually considered a perennial, English rye-grass is short-lived and is very little better than Italian rye-grass in this respect. In England, where these grasses occupy a similar position in agriculture to that of timothy in the United States, it is a common practice to allow seed to mature before they are cut for hay. In this way they reseed themselves and last from year to year. It is claimed also that this is a safe thing to do so far as the quality of the hay is concerned.

The seed of these grasses is usually of good quality and germinates well. It weighs from 14 to 20 pounds per bushel. It may be sown in the spring, but early fall seeding gives the best results in this region. When sown alone from 25 to 40 pounds of seed per acre should give satisfactory stands. The rye-grasses sown with clover make excellent silage.

ORCHARD GRASS.

Orchard grass (*Dactylis glomerata*) thrives remarkably well on all tillable soils west of the Cascade Mountains, except those that are very wet. It is the earliest grass to start to grow in the spring; it revives quickly after it is cropped by stock or cut for hay, especially if the soil is moist; it remains green during the summer and fall, and is relished fairly well by all kinds of stock; it stands grazing and tramping much better than timothy, and lasts for a number of years when given proper care. It is, therefore, eminently adapted for pasture purposes and should form an important part of every permanent pasture mixture.

Orchard grass makes an excellent quality of hay if cut before or just after the blooming period. If the cutting is delayed but a few days beyond this period orchard grass has a strong tendency to become woody, and the hay is then of poor quality. It ripens with red clover, and under favorable circumstances it may be cut twice during a season. It is, therefore, especially well fitted for sowing with red clover when intended for hay. It grows in bunches and does not make a smooth sod; for this reason it is seldom sown alone. Orchard grass is a little early, and is often ready to cut before good haying weather has begun. This fact and its tendency to become woody immediately after blooming are the chief drawbacks to its culture west of the Cascade Mountains. Its earliness is an advantage, however, when it is used for ensilage or soiling.

The seed habits of orchard grass are very satisfactory, and the yield is from 15 to 18 bushels of seed per acre. The seed weighs from 14 to 18 pounds per bushel. When sown alone 20 to 25 pounds of seed per acre will be sufficient. It is sown either in the fall or spring. If sown in the early fall, without a nurse crop, it should make an excellent crop the next year.

MEADOW FESCUE.

Although meadow fescue (*Festuca pratensis*) is grown but little west of the Cascade Mountains, it is highly prized by those who know it. Like orchard grass, it is adapted to practically all of the tillable soils of the region except those that are gravelly or very wet. It is a perennial; lasts much better than timothy; is relished by all kinds of stock; makes a good quality of hay; and, when once established, stands tramping and grazing well. It does not begin to grow so early in the spring as orchard grass, but remains green during the summer and makes a good growth during the fall. It is especially adapted to a place in meadow and pasture mixtures that are to occupy the land for a number of years. One of the leading dairymen of the Willamette Valley sows the following mixture in the spring: Meadow fescue, 10 pounds; English rye-grass, 10 pounds; timothy, 4 pounds; red clover, 4 pounds, and alsike clover, 2 pounds. This mixture is used for hay for two years, and then for pasture three years. Of the grasses in this mixture, meadow fescue is his favorite.

Meadow fescue may be sown in the early fall or spring. When sown alone, from 15 to 20 pounds per acre of the best seed should be used. If the quality of the seed is doubtful, sow more. Kansas farmers who grow their own seed sow only 12 to 15 pounds per acre.

VELVET GRASS.

> The only part of the United States in which velvet grass occurs to an extent worthy of notice is on the Pacific coast west of the Cascade Mountains, from northern California to the Canadian line. In that section it is indifferently called velvet grass and mesquite. The latter name should never be applied to this grass, as it is used for several other very different grasses in the Southwest.
>
> It is generally regarded as a pest on the Pacific coast, particularly on lands that are very wet in winter and very dry in summer. This is especially the case with both sandy and peaty soils on the coast. It is not utilized for feed in many localities, but on the extensive areas of sandy land around the mouth of the Columbia River and at one or two points inland it is the chief reliance, both for hay and pasture. It yields ordinarily about half a ton of hay per acre. The hay is remarkable for its lightness, a ton of it being much more bulky than a like weight of other kinds of hay. Horses nearly starve before they acquire a taste for velvet grass, but when the taste is once acquired they thrive upon it remarkably well, showing that it is highly nutritious. The whole plant is covered by a growth of wool-like hairs, from which fact the name is derived. It is unworthy of attention except on the classes of soils above mentioned. On these soils it drives out all other grasses.[a]

Velvet grass (*Holcus lanatus*) is frequently a pest in meadows. The seed matures very early, is light, and shatters readily. When clover, rye-grass, and timothy are ready to cut for hay the seed of velvet grass is usually mature enough to germinate. The wind blows the seed, and wherever the hay is hauled or handled the seed is scattered. If a meadow that is infested with velvet grass is cut a little early for either hay or ensilage, the seed can not be spread in this way. Velvet grass gives no trouble in the second crop of clover. Fence rows and waste places beside meadows should be mown early enough to prevent seed from maturing. If these precautions are taken the grass can be prevented from becoming very troublesome.

---

[a] W. J. Spillman, in "Farm Grasses of the United States."

To eradicate velvet grass cut it early, before the seed is ripe, generally from the 10th to the 20th of June. About the 1st of July give it a thorough but shallow disking. Repeat the shallow disking every week until the 1st of August and then spring-tooth and disk again. This shallow cultivation during the driest season will kill the roots and leave the ground with a very fine mulch on top and plenty of moisture in the subsoil. The land may then be reseeded to clover or planted to any crop desired.[a]

INDIAN CORN.

The climatic conditions of western Oregon and western Washington are not well adapted to the growing of corn (*Zea mays*). The nights are too cool for its best development, and unless very early varieties are grown difficulty is often experienced in bringing it to maturity. Nevertheless corn fills an important place in the cropping systems of this region, particularly on dairy farms; i. e., for ensilage and for feeding green during August, September, and October. While it may be impracticable to grow corn for the grain, it is possible by selecting very early varieties and using seed grown near by to grow a good quality of ensilage corn. The aim should be to grow those varieties that reach as near maturity and yield as much grain as possible. The large southern varieties produce very little grain here, and are so immature when put into the silo at the end of the season that too much acid develops.

The following table gives the quantity of water and dry matter in corn at different stages of growth, as determined by the New York (Geneva) Agricultural Experiment Station:

Water and dry matter in corn at different periods after tasseling.

Date of cutting.	Stage of growth.	Corn per acre.	Water per acre.	Dry matter per acre.
		Tons.	*Tons.*	*Tons.*
July 30	Fully tasseled	9.0	8.2	0.8
Aug. 9	Fully silked	12.9	11.3	1.5
Aug. 21	Kernels watery to full milk	16.3	14.0	2.3
Sept. 7	Kernels glazing	16.1	12.5	3.6
Sept. 23	Ripe	14.2	10.2	4.0

This table is very interesting. The last column shows the dry matter of corn at different stages of growth. Ripe corn yields five times as much dry matter per acre as corn that is fully tasseled, two and two-thirds times as much as corn fully silked, and nearly one and three-fourths times as much as corn in the milk; hence, the importance of growing corn for ensilage that will mature. The table also shows the great waste in feeding corn green instead of letting it mature properly and making it into ensilage.

---

[a] Letter from W. H. Kaufman, Bellingham, Wash.

In order that ensilage may keep well, corn should be cut about the time the kernels are well glazed and dented. If it is cut too green, as stated, too much acid develops; if cut too ripe it does not settle properly and the air is not sufficiently excluded to prevent spoiling. The ripest corn should always be cut first and placed in the bottom of the silo, because the great pressure near the bottom will tend to exclude the air.

If planted on rich, mellow, well-drained land between the middle of May and the first of June, corn should be ready for feeding green from about the 1st to the 15th of August. As previously stated early varieties should be planted, and seed grown west of the Cascade Mountains succeeds better than eastern seed.

RAPE.

Rape (*Brassica napus*) has been grown in the Willamette Valley with excellent results for twenty years. It is a succulent, nutritious forage plant, admirably adapted to the moist, mild climate of the Pacific coast. It stands considerable freezing, and is seldom winter-killed west of the Cascade Mountains. It does best on deep, warm, well-manured loamy soils. It succeeds well also on peaty soils, but is not adapted to very light sandy or heavy clay soils. It is a heavy feeder, and must not be expected to succeed on poor, worn-out land.

Rape is an excellent crop for pasture or soiling, i. e., for cutting and feeding green for hogs, sheep, goats, and poultry. Fed to dairy cows it causes a large flow of milk, but to avoid tainting the milk it should be fed immediately after milking, at the rate of 30 to 50 pounds per day, in two feeds. On account of danger of bloating, sheep, goats, and cattle should never be turned on rape for the first time when they are hungry, or when the rape is wet with dew or rain. They should have plenty of something else to eat first, and plenty of salt at all times. It is a good plan to give them access to hay or a grass pasture to prevent overloading on rape. When sheep have become accustomed to it they may be left on it continually with but little danger.

Rape is grown and utilized west of the Cascade Mountains in several different ways:

(1) When grown for early summer use, the largest yields and the best results are secured by making a succession of plantings at intervals of two or three weeks, beginning in the early spring as soon as the ground can be put into perfect tilth. The ground should be well manured and the seed planted in drills 24 to 36 inches apart at the rate of about 2 pounds per acre. A common garden drill may be used

in planting small areas, but for larger fields a grain drill, with some of the feed hoppers closed to make the rows the desired distance apart, answers the purpose best. As soon as the plants are sufficiently large they should be cultivated often enough to control the weeds and keep the soil in good tilth. The cultivation will retain the soil moisture and tend to keep the plants growing vigorously. Unless cultivated during the dry portion of summer, growth almost ceases until the fall rains come. Rape grown in this way may be used either for pasture or for soiling.

When rape is used for soiling purposes it should be cut at least 5 inches high, so that the plants will have a chance to grow again. In from six to eight weeks after planting it should be large enough to cut; by making a succession of plantings green, succulent feed should be on hand throughout the summer. If rape is used for pasture, the best results will be secured by having a number of small fields which are pastured alternately. It may be fed in this way also by means of movable fences. Rape should be from 12 to 14 inches high before it is used for pasture, and hogs should be prevented from rooting while in the field. When rape is removed by cutting or pasturing closely, the evaporation of soil moisture is rapid, and it should be cultivated as soon as possible if a second growth is desired. If sown in drills, stock will walk between the rows while feeding, and much less will be broken down and destroyed than if they were feeding upon rape that was sown broadcast. A larger yield is also secured by planting rape in rows and cultivating it.

(2) Another favorite way of growing rape is to sow it broadcast at intervals in the spring. The land is plowed and thoroughly worked in the early spring, as soon as it is in good working condition, and then allowed to lie until the seeding is done. Just before each piece is sown the ground is cultivated thoroughly again and from 3 to 4 pounds of seed sown and covered with a harrow or cultivator. Instead of sowing the seed broadcast it is sometimes planted with a common grain drill. Rape sown the 1st of May should be ready for pasture the 1st of July; if sown the 1st of June, it should be ready for pasture by the 1st of August. Grown in this way rape makes excellent pasture during the summer, fall, and early winter.

(3) Another method of raising rape that is popular with many farmers, especially those who raise sheep or goats, is to grow it with clover. The method of doing this has already been fully described in the discussion of red clover (page 16).

(4) Rape is sometimes sown with oats in the spring on a thoroughly prepared seed bed. The oats are used for either hay or grain. The rape grows but little until the early fall rains come, after which it is soon ready for pasture. From 2 to 4 pounds of rape seed per acre are sufficient when sown in this way.

(5) From 3 to 4 pounds of rape seed per acre are also sown with corn just before the last cultivation. The seed is then covered by the cultivator and the rape comes on and makes good pasture as soon as the corn is harvested. It may also be sown with potatoes, but it does not succeed so well with them as with corn, for the digging of the potatoes destroys much of the rape. Sown after early potatoes are dug, it gives good pasture during the late fall and early winter.

THE SEED CROP.

Good rape seed is now produced in the Willamette Valley and the region about Puget Sound, and there is no reason why farmers should not produce their own seed. Rape is a biennial and does not produce seed when sown in the spring until the second year. If sown in September or October it matures seed the following June. Rape may be cross-fertilized by kale, cauliflower, and other closely related plants. It is believed to cross also with wild mustard, and wild turnips; hence none of these plants should be allowed to grow near rape that is intended for seed.

For seed, rape should be sown alone, and it is very desirable to have in it drills in order to cultivate it and keep it free from the plants mentioned. Rape that is planted in drills in the spring may be used for soiling during the summer and fall, carried through the winter, and used for a seed crop the second season. If sown entirely for a seed crop, it may be planted in the fall—September or October—after some early crop has been removed. To retard development of the plants so that the seed will mature after the late spring rains are over, it should be pastured or cut back about the last of April or the first of May. If ripe rape gets wet the seed shatters very readily, and the retardation of the development of the crop is often very necessary in order to have good weather for harvesting the seed.

Rape should be cut for seed when the first seeds are turning brown. It may be cut with a binder or a self-raking reaper. It should be shocked in such manner that it will dry out quickly. Birds destroy considerable of the seed; hence it should be thrashed as soon as dry. If the crop is not too extensive a man with a team and sled may drive from shock to shock and thrash it by hand. If a thrashing machine is used, it should be hauled to the machine in tight-bottomed racks, or canvas should be spread over the racks to catch the shattered seed. It is said that a yield of 1,000 pounds of seed to the acre is not unusual in the Willamette Valley.

Seed may be purchased of local seedsmen. When buying seed, however, one should always call for Dwarf Essex rape. There are a number of varieties of rape, some of which are annuals and are grown only for bird seed. If these annuals are sown in the spring they produce seed the same year and are liable to become serious pests when once introduced. Complaint has been made that Dwarf Essex rape becomes a weed, but it is easily controlled. It does not produce seed until the second season, and if plowed under during the fall, winter, or spring no seed can be produced.

THOUSAND-HEADED KALE.

Thousand-headed kale (*Brassica oleracea*) has been grown in the Willamette Valley for 27 years. It attracted little attention among the dairymen until recent years, but is now rapidly becoming a very popular fall and winter soiling crop. It stands the mild winters west of the Cascade Mountains admirably and is hauled from the field and fed as needed. It does not head up like cabbage, and the name "thousand-headed" is given it on account of the numerous branches the plants have when given plenty of room. It is very much like rape, but the plants are much taller and the leaves are longer and broader. A field of this crop is shown in figure 2. It is claimed that kale will yield 30 to 40 tons of green feed per acre when grown under favorable conditions.

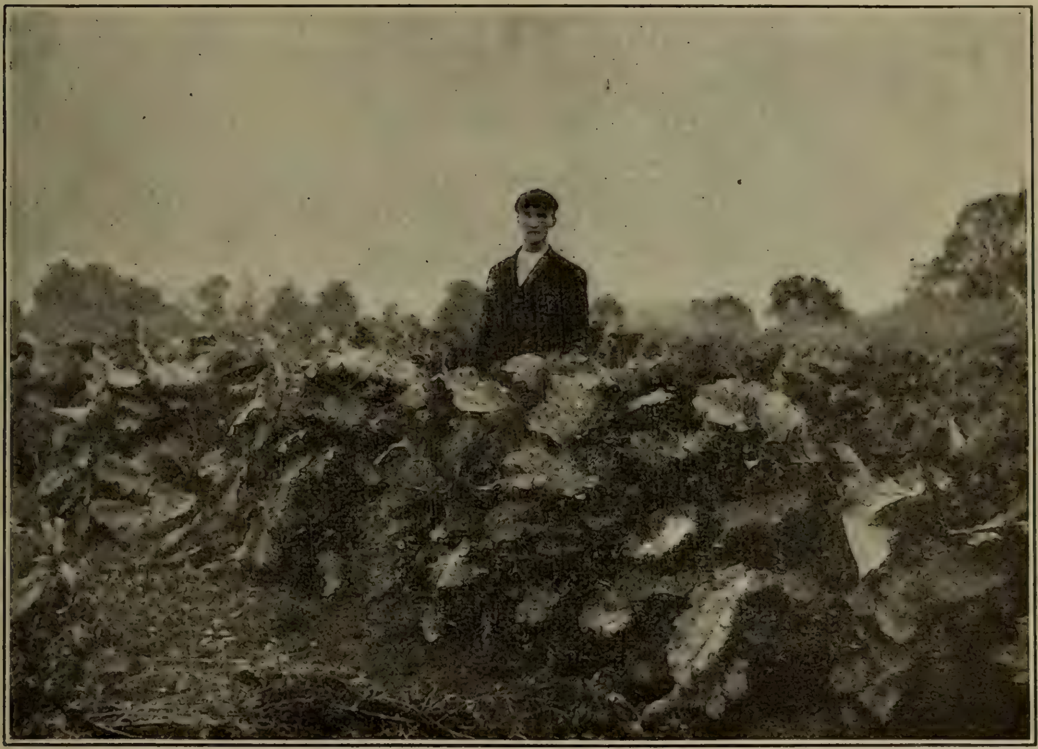


FIG. 2.—A field of thousand-headed kale on Martins Island, near Kalama, Wash. A valuable winter soiling crop, available from October 1 to April 1.

Kale is used for table greens, but its chief use on the Pacific coast is for feeding green to dairy cows from October to April, for which it is highly prized. It would undoubtedly be an excellent winter feed also for hogs and poultry. It does best on well-manured, deep, rich loams and sandy soils. The only objection to the use of kale is the difficulty of getting it out of the field when the ground is wet and muddy. For this reason well-drained land should be selected upon which to plant this crop.

METHODS OF SOWING.

For fall and winter use, kale is usually sown in drills on well-prepared and well-drained soil as soon after the 15th of March as the season will permit. This furnishes plants for transplanting in June and July. The land used for transplanting is well manured and plowed two or three times between the 1st of March and the 1st of June. With the land in perfect tilth it is plowed again with a 12-inch plow about the 1st of June and the young kale plants dropped into every third furrow about 2½ to 3 feet apart. This places about one plant on every square yard. The roots of the plants are placed where the next furrow covers them, leaving the tops uncovered. The plants that are plowed in during the day in this way are rolled in the evening of the same day to pack the ground. Two or three cultivations are all that can usually be given, for the plants will soon touch in the row if they do well. Any plants that fail to grow may be replaced by hand. Some growers prefer to plant the seed in hills, and when the plants are large enough thin them to one plant in a hill. Others put kale out just as cabbage is usually transplanted, instead of plowing it in. The time of transplanting must be determined by the size of the plants and the condition of the land. If the land is wet and subject to overflow the transplanting may be delayed until during July. If the land is well drained and the plants are large enough it may be done before the 1st of June. In transplanting, enough plants may be left for a stand on the land where the seedlings are grown.

FEEDING.

As previously stated, kale stands in the field during the winter and is hauled in and fed green as needed from about the 1st of October to the 1st of April. If the growth is forced in the early spring it can be fed much earlier than the 1st of October. To avoid tainting the milk, kale is fed just after milking, at the rate of 25 to 50 pounds per day, in two feeds. Some let it wilt before feeding. Enough may be hauled in at a time to last four or five days. It should not be thrown into heaps and allowed to heat. Neither should it be fed when frozen. On the approach of freezing weather a supply sufficient to last several days may be placed in the barn.

To haul kale from the field during wet weather it is best to wear a gum coat and gum boots. The plants can then be cut off at the surface of the ground with an ax, thrown into piles, and loaded on a wagon with a pitchfork without serious inconvenience to the worker.

Kale grows a great deal during the fall and winter, and much is lost by feeding the whole plant in the early part of the feeding season. By using only the lower leaves it is possible to begin feeding quite early without stopping the growth of the plants. With the thumb and fingers of the hand extended, one can break off all of the lower leaves of a large plant with three or four downward strokes of the hand. This is not practicable, however, during damp weather, for the leaves would be too wet to handle in this manner.

THE SEED CROP.

An excellent quality of kale seed is produced in the Willamette Valley. Like rape, it is a biennial and does not produce seed until the second year. Richard Scott, a dairyman of the Willamette Valley, has grown kale for twenty-seven years. He produces seed about as follows: There is considerable variation in the types of individual plants. During the first year plants with many rather narrow leaves that begin spreading from near the surface of the ground are selected. This type of plant yields more and stands freezing better than a plant the stem of which is bare for some distance above the ground. These selected plants are transplanted in February in some isolated place to prevent cross-fertilization by undesirable kale plants, rape, cauliflower, and other closely related plants. It is believed that kale crosses with wild mustard and wild turnip; hence none of these plants should be allowed to grow near kale that is intended for seed. The seed crop is cut when the first seeds are turning brown. If the crop is small, it is usually thrashed by hand. A large crop may be handled the same as a seed crop of rape. Birds are fond of the seed, and for this reason it should remain in the field only until dry.

ROOT CROPS.

Since the soil requirements and the methods of culture of mangel-wurzels (*Beta vulgaris* var. *macrorhiza*), carrots (*Daucus carota*), and ruta-bagas (*Brassica campestris*) are very similar, they will be treated collectively. Like rape and thousand-headed kale, they succeed best where the weather is moist and cool. Hence their eminent adaptation to western Oregon and Washington. In this region the yield of these crops is enormous, the ordinary yield being from 20 to 35 tons per acre, while reports of 45 or 50 tons are not infrequent.

Root crops usually succeed best on deep, moist, friable loam soils. On clay land they grow too slowly, and the soil is also difficult to work. Ordinarily, land for roots is heavily manured in the fall and then plowed considerably deeper than for other crops. If the soil runs together badly during the winter, it is replowed in the early spring. Instead of the above procedure, the manure is sometimes spread during the winter, the land plowed deep in the early spring, and a fine, firm seed bed formed immediately by disking, harrowing, rolling, planking, etc., as the conditions may require. Between the preparation of the seed bed in the early spring and planting the seed during April or early in May the land is cultivated sufficiently to keep the weeds subdued. Just before planting the seed a thorough cultivation is given, finishing with a planker or clod masher. This destroys the weeds, thoroughly pulverizes the soil, and leaves the surface smooth and in good condition for planting.

Mangel-wurzels and ruta-bagas are usually grown in rows from 22 to 30 inches apart. When planted in continuous rows, enough seed is used to insure a good stand. When sown with a hill-dropping planter, the hills are from 8 to 15 inches apart and 4 or 5 seeds are dropped in each hill. The rows of carrots are usually 18 inches apart and the hills 8 inches.

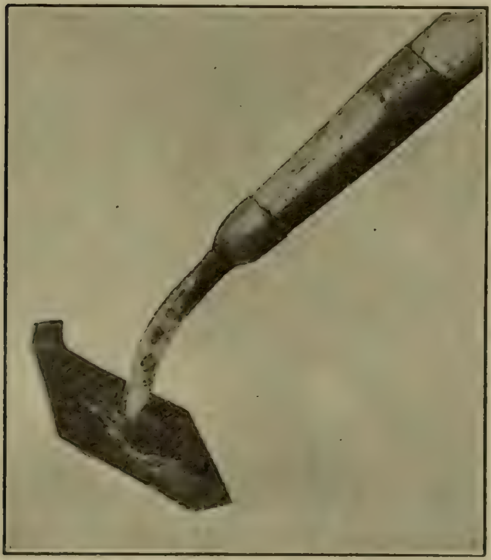


FIG. 3.—A "scuffle" hoe devised and used by W. J. Langdon, Sumner, Wash., in thinning and weeding root crops. A very effective implement.

As soon as the plants can be seen in the rows, the wheel hoe is started. With the guards of the hoe next to the row, the cultivation is done as close to the row as possible without covering or disturbing the plants too much. Considerable hand weeding and hoeing between the hills and along the rows is usually necessary. When the plants are 3 or 4 inches high, they are thinned, leaving the most vigorous plant in each hill. When sown in continuous rows, the thinning is largely done with a hoe, striking across the row. Subsequent cultivation should at least be sufficient to keep the weeds under control. As much of it as possible is usually done with a horse cultivator.

Instead of the common and wheel hoes for thinning and weeding, some prefer to use a "scuffle" hoe. (See figs. 3 and 4.) When in use, the blade of such hoes is in a horizontal position and is pushed and pulled just under the surface of the ground. The blade shown in figure 3 is diamond shaped, about 2 inches wide in the middle and one-half inch wide at each end, and about 8 inches long. About an inch of the tip of one end is turned up at a right angle to form a guard for working close to small plants. The blade of the hoe should be sharp on both edges, so that it will cut each way when pushed and pulled. In order to make it take hold properly, it may be necessary to bend the edges of the blade down slightly. To give the handle the proper angle, the shank should be curved. It should flatten out into a narrow, thin plate about 2 inches long and fasten to the blade by means of two rivets. This hoe is not on the market, but may be made by any blacksmith. An old saw makes excellent blades. The shank should be made of Norway iron, so that it may be bent to give the handle the proper angle.

Ruta-bagas are sometimes sown in drills in the early spring and transplanted like cabbage. The plants may be transplanted like kale, as the land is plowed. The roots of the plants are placed where the next furrow will cover them and the tops are left sticking out. For this method of transplanting, see the discussion of kale.

About the 1st of November the roots are topped, pulled, and placed in narrow bins in the barn. Upon the approach of cold weather they are covered with hay or straw. The tops are sometimes cut off with a sharp hoe and the roots then dug with a potato fork. More generally they are dug first, the worker pulling on the top of the root with one hand as he bears down upon the handle of the potato fork with the other. The roots of two or three rows are laid together with the tops one way. The tops are then cut off with a long-handled knife. Some twist the tops off, claiming that the roots do not bleed and wither so much as they do when the tops are cut off. Roots are grown mostly for winter use and are fed up to the 1st of April. They are generally sliced before being fed to dairy cattle. Some dairymen feed them whole, claiming that cows can handle large roots nicely and that, unless the slicing is carefully done, they do not choke so frequently when feeding on whole roots as they do on sliced roots.

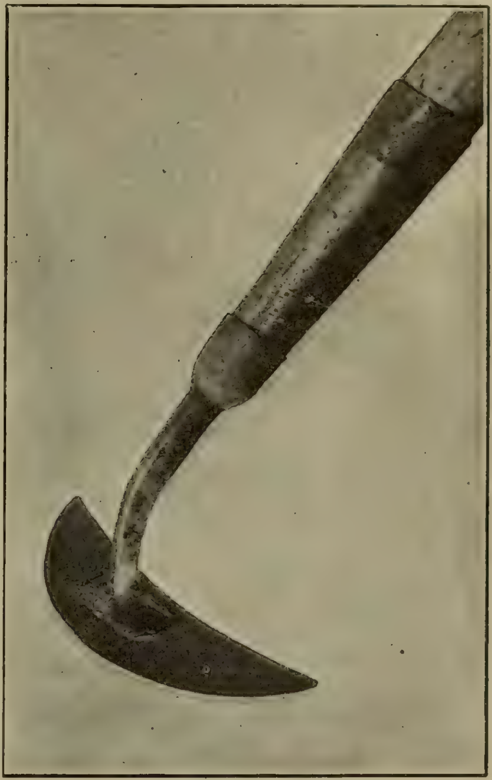


FIG. 4.—A "scuffle" hoe similar in principle to that shown in figure 3, devised by A. B. Leckenby, Seattle, Wash. The blade of either of these hoes may be made from an old saw blade.

The flat or fall turnip (*Brassica rapa*) is also grown in western Oregon and Washington. Since it matures quickly, grows mostly above ground, and has a flesh less firm than that of other roots it does not keep well and is adapted only to fall and early winter use. Its soft flesh and habit of growth above ground make it an admirable root to be harvested by stock turned into the field. It is usually sown broadcast on clean land about the 1st of July. It may be sown also in corn. If intended for winter use it should be gathered and put into bins before becoming water-soaked from fall rains.

SOILING (GREEN FEEDING) CROPS.

The mild winter climate and abundant rainfall of western Oregon and Washington make it almost an ideal region for the production of soiling crops. By the judicious selection and planting of crops green succulent food may be provided for the dairy cow during practically the entire year. That a much greater amount of feed can be obtained from the same area of land by this system as compared with pasturing is a fact well recognized by progressive dairymen. Much of the tillable land of this region is now very valuable. As values advance beyond the limit where farm land may profitably be used for pasture and it becomes necessary for the small farmer to keep the maximum number of stock upon his few acres of tillable land, the growing of soiling crops becomes of vital importance.

Below is given a list of the crops that are used for this purpose. The dates of planting and the approximate dates upon which these crops may be used are also given. It must be understood, however, that the variation in seasons prevents one from saying definitely when a crop will be ready to use. For further information regarding these crops the reader is referred to the discussion of each in the preceding pages of this bulletin.

Dates for planting and using soiling crops in western Oregon and western Washington.

Crops.	When planted.	When used.
Rye and vetch	September 1 to 15	April 1 to May 15.
Winter oats and vetch	September and October	May 15 to July 1.
Winter wheat and vetch	do	Do.
Red clover		Do.
Alfalfa		During June.
Oats and peas	February	Do.
Oats and vetch	do	June 15 to July 15.
Oats and peas	April	During July.
Rape	May 1	Do.
Oats and peas	May	During August.
Rape	June	Do.
Corn	May 10 to 20	During August, September, and October.
Turnips	July 1	Late fall and early winter.
Thousand-headed kale	March 15 and transplanted June 1.	October 15 to April 1.
Mangel-wurzels, carrots, and ruta-bagas.	April	October 15 to April 1 (fed from bins, pits, or root houses).

SEEDING TIMBER BURNS AND BURNT SLASHINGS.

As previously stated, dense forests of evergreen timber cover a very large portion of western Oregon and western Washington. During the dry season of the year forest fires overrun large areas, killing practically all vegetation, and leaving a loose blanket of ashes on the surface of the ground. These burnt areas if left unmolested for a few years usually produce a dense growth of young trees and brush and are practically worthless for grazing purposes. In clearing land it also frequently happens that the timber and brush are slashed and burnt several years before the stumps are removed. By properly seeding these burnt areas they may be made to produce excellent pasture. Since the stumps are in the ground and there is therefore no chance to cover the seed, the seeding should always be done in the fall before the ashes have settled. The first rain that comes will then cover the seed sufficiently to insure good germination.

Since there is little chance to improve or renew the stand on account of the stumps and timber remaining on the land, only seed of those plants should be sown that last a long time, stand close cropping, and yet produce as much growth as possible. If the seed is sown in the unsettled ashes as indicated, little difficulty will be experienced in getting good stands of white clover, alsike clover, red clover, orchard grass, meadow fescue, timothy, and English rye-grass. A mixture of 1 pound of white clover, 3 pounds of alsike clover, 10 of orchard grass, and 10 pounds of meadow fescue per acre should give satisfactory results when sown in the unsettled ashes in the early fall. Timothy will also do well for this purpose. Red clover and English rye-grass are each short-lived and should form but a small portion of the mixture, if sown at all. Timber burns that have been seeded down in this way should be pastured pretty closely to keep down the young trees and brush. Goats will help to do this better than any other kind of animal. The success of seeding burnt areas in this way has been thoroughly demonstrated in many parts of the region. It is only a question of sowing the proper seed at the proper time.

○

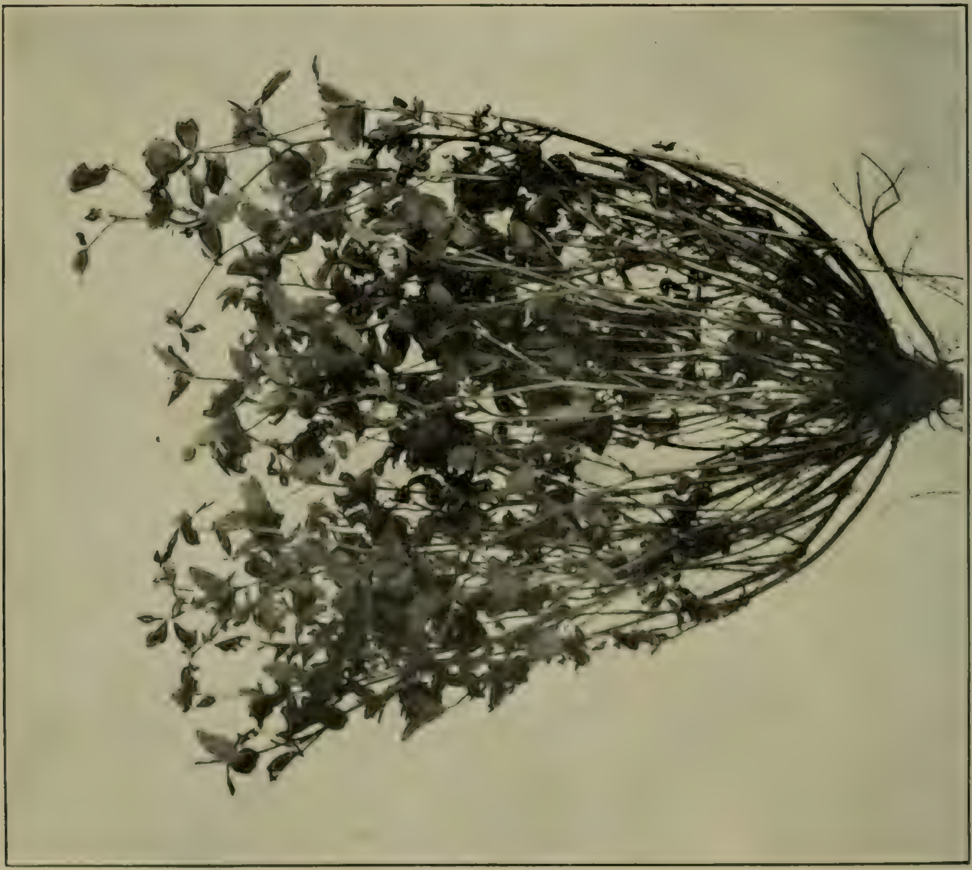


FIG. 1.—PLANT OF HAIRLESS OREL CLOVER, ALMOST MATURE.

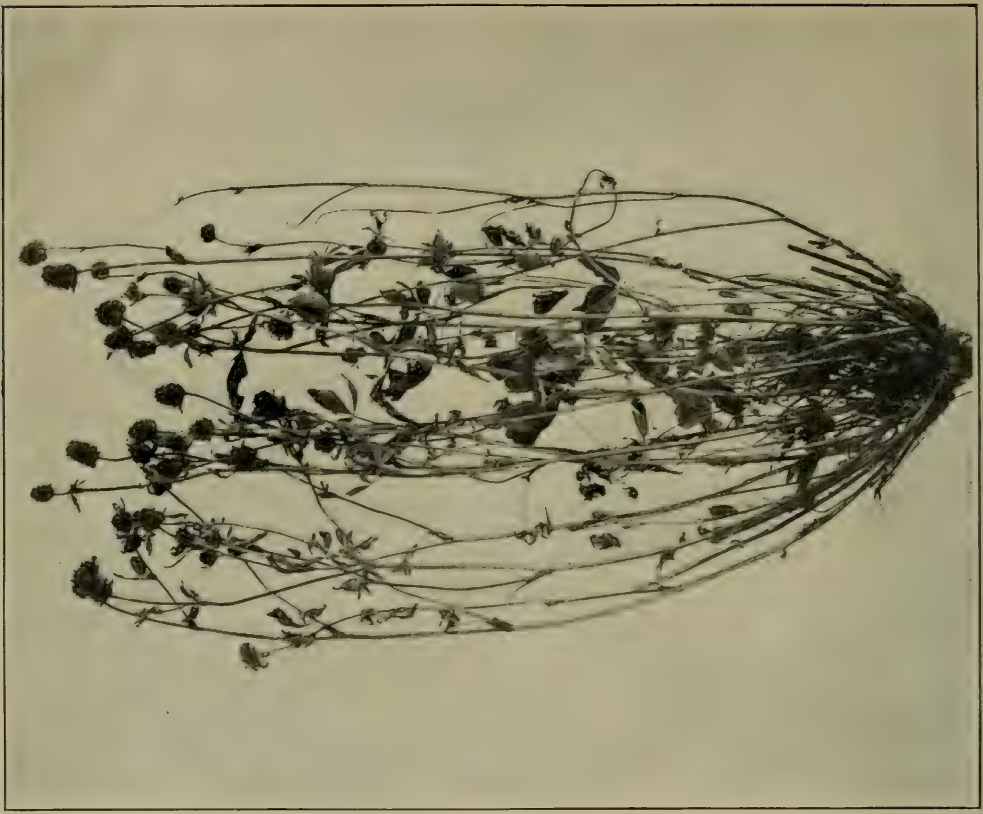


FIG. 2.—MATURE PLANT OF AMERICAN RED CLOVER.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 95.

B. T. GALLOWAY, *Chief of Bureau.*

A NEW TYPE OF RED CLOVER.

BY

CHARLES J. BRAND,
Assistant Physiologist, Laboratory of Plant
Life History.

Issued October 3, 1906.

239409
13.. 1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

BUREAU OF PLANT INDUSTRY.

SCIENTIFIC STAFF.

Pathologist and Physiologist, and Chief of Bureau, Beverly T. Galloway.
Pathologist and Physiologist, and Assistant Chief of Bureau, Albert F. Woods.

PATHOLOGICAL INVESTIGATIONS.

Laboratory of Plant Pathology, Erwin F. Smith, Pathologist in Charge.
Diseases of Fruits, Merton B. Waite, Pathologist in Charge.

PHYSIOLOGICAL INVESTIGATIONS.

Plant Breeding, Herbert J. Webber, Physiologist in Charge.
Plant Life History, Walter T. Swingle, Physiologist in Charge.
Soil Bacteriology and Water Purification, Karl F. Kellerman, Physiologist in Charge.
Bionomic Investigations of Tropical and Subtropical Plants, Orator F. Cook, Bionomist in Charge.
Drug and Poisonous Plant Investigations and Tea Culture Investigations, Rodney H. True, Physiologist in Charge.
Physical Laboratory, Lyman J. Briggs, Physicist in Charge.

TAXONOMIC INVESTIGATIONS.

Economic Collections, Frederick V. Coville, Botanist in Charge.

AGRONOMIC INVESTIGATIONS.

Farm Management, William J. Spillman, Agriculturist in Charge.
Grain Investigations, Mark A. Carleton, Cerealist in Charge.
Arlington Experimental Farm, Lee C. Corbett, Horticulturist in Charge.
Sugar-Beet Investigations, Charles O. Townsend, Pathologist in Charge.
Western Agricultural Extension, Carl S. Scofield, Agriculturist in Charge.
Dry Land Agriculture, E. Channing Chilcott, Expert in Charge.

HORTICULTURAL INVESTIGATIONS.

Pomological Collections, Gustavus B. Brackett, Pomologist in Charge.
Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge.
Experimental Gardens and Grounds, Edward M. Byrnes, Superintendent.

SEED AND PLANT INTRODUCTION INVESTIGATIONS

Seed and Plant Introduction and Distribution, David Fairchild, in Charge.
Seed Laboratory, Edgar Brown, Botanist in Charge.

SPECIAL LABORATORIES, GARDENS, AND FARMS.

Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge.
Subtropical Laboratory and Garden, Miami, Fla., Ernst A. Bessey, Pathologist in Charge.
Plant Introduction Gardens, Chico, Cal., Palemon H. Dorsett, Pathologist in Charge.
Cotton Culture Farms, Seaman A. Knapp, Lake Charles, La., Special Agent in Charge.

Editor, J. E. Rockwell.
Chief Clerk, James E. Jones.

PLANT LIFE HISTORY INVESTIGATIONS.

SCIENTIFIC STAFF.

Walter T. Swingle, *Physiologist in Charge.*
Charles J. Brand, *Assistant Physiologist.*
Silas C. Mason, *Special Agent.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., July 20, 1906.

Sir: I have the honor to transmit herewith a manuscript entitled "A New Type of Red Clover" and to recommend that it be published as Bulletin No. 95 of the series of this Bureau. This bulletin was prepared by Mr. Charles J. Brand, Assistant Physiologist in Plant Life History Investigations, and has been submitted by Mr. A. F. Woods, Assistant Chief of Bureau, with a view to publication.

Considering the great extent of the area suited to its cultivation, red clover is the most important forage plant and manurial force in modern agriculture. Its high value as a feed, its power of renewing and increasing the fertility of the soil by the fixation of free nitrogen, its fitness for nearly all rotations, and the fine physical condition in which it leaves the soil on account of its root development all contribute to make success in its cultivation a matter of vital importance to the profitableness of farming in a large part of the United States.

In the course of his studies on life history, seed production, and change of seed, Mr. Brand has encountered a European strain of red clover hitherto not recognized in this country, the seed of which was obtained from Orel in the "Black Earth" region of Russia, which promises to prove of exceptional value both on account of its yielding power and the fine quality of hay which it produces.

In the accompanying bulletin are described the performance and characteristics of the plant itself, the sections where and the conditions under which its culture may be expected to produce the best results. The new type is not recommended to take the place of our home-grown strains, but to supplement them. It is not believed that it will be so well adapted to all parts of the clover region as to the Northwest, but it is hoped that it may help to extend the boundaries of the present clover-growing area.

The work covered by this report has been carried on in cooperation with the Seed Laboratory and with the assistance of the Office of Seed and Plant Introduction and Distribution, through which all seed used in the experiments was purchased.

The accompanying illustrations are necessary to a full understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

Page.
Introduction 9
The importance of clover culture 10
Domestic versus foreign seed 11
Objections of European growers to American red clover 11
Hairy clover a cause of bloating 12
Some general objections to the growing of clover 12
Certain objections overcome by new type of clover 12
Disadvantage of lateness of maturing under some conditions 13
Heavy yield of first crop and accruing advantages 13
Other points of excellence of hairless clover 13
Effect of persisting basal leaves on quality of hay 14
Lateness of hairless clover with reference to insect ravages 15
Effect of lateness of maturing when seed production is desired 16
Sections particularly suited to the cultivation of the new type 16
Seed of new type indistinguishable from ordinary form 16
Plans of experiments, origin of seed, and methods of procedure 17
Sources of Russian clover seed except No. 16 18
Source from which Russian seed No. 16 was obtained 19
The soil and climate of Orel 19
Purity and germination of seed used in experiments 21
Detailed description of experiments 22
  The experiment in Nebraska 22
    Location 22
    Soil 22
    Drainage 23
    Preparation of land and seeding 23
    General weather conditions during 1904 23
    Comparison of strains of clover on entering the winter of 1904 23
    Comparison of early growth of certain strains of clover 24
    Weather during growing season of 1905 25
    Earliness of varieties and order in which they matured 25
    Yield of the Orel clover compared with other strains 27
  The experiment in South Dakota 27
    Location 27
    Soil and drainage 28
    Preparation of land, seeding, and subsequent treatment 28
    Weather conditions during 1904 and 1905 29
    Comparison of yields 30

Detailed description of experiments—Continued. Page.
The experiment in Minnesota ... 31
Location, soil, and drainage ... 31
Preparation of land, seeding, and subsequent treatment ... 32
Weather conditions during 1904 and 1905 ... 32
Comparative condition of different strains of clover in the spring of 1905 ... 32
Yields of green matter ... 33
Comparison of clover No. 16 with other strains ... 33
Yields of field-cured hay ... 34
Order in which the various strains matured ... 34
Comparison of yields of field-cured hay ... 35
The experiment in North Dakota ... 35
Location, soil, and drainage ... 35
Preparation of land, seeding, and subsequent treatment ... 37
Weather conditions during 1904 and 1905 ... 37
Comparison of yields ... 38
Other experiments in which clover No. 16 was included ... 39
Description of new type and name proposed ... 41
Later observations ... 42
Summary ... 44
Description of plates ... 48

ILLUSTRATIONS.

PLATES.

Page.

Plate I. Fig. 1.—Plant of hairless Orel clover, almost mature. Fig. 2.—Mature plant of American red clover . . . . . Frontispiece.

II. Fig. 1.—Stems, stipules, and bases of petioles of American and of hairless Orel clover. Fig. 2.—Young plants of hairless Orel clover and American red clover, showing smooth and hairy types 48

III. Fig. 1.—Large plats used in clover experiments, North Dakota Agricultural College. Fig. 2.—Small plats used in experimental work, Ontario Agricultural College and Experiment Station, Guelph, Canada 48

TEXT FIGURES.

Fig. 1. Map of the United States, showing locations of experiments, sources of seed, and general boundaries of the clover region 9

2. Plant of *Trifolium pratense* var. *foliosum*, showing persisting basal leaves . . . 14

B. P. I.—216.

A NEW TYPE OF RED CLOVER.

INTRODUCTION.

In the course of an investigation now in progress on the life history, seed production, and change of seed of medium red clover (*Trifolium pratense*), there has appeared a hairless Russian variety, new to the United States, of such unusual promise as to make it seem desirable to publish the observations thus far recorded concerning it.

At the present time clover culture is carried on in a large, though quite well-defined area of the United States, often called the clover region, shown on the accompanying map (fig. 1). Ohio, Indiana, and Illinois are the most important clover-producing States of this region, the boundaries of which may be defined about as follows: It is limited on the north by the forty-fifth parallel of latitude; on the east by the Atlantic Ocean; on the south by the thirty-fifth parallel, and on the west by the ninety-seventh meridian. These boundaries do not, of course, mark the absolute limits of clover culture, and it is almost unnecessary to say that there are large tracts within this so-called clover region where attempts to grow red clover are not

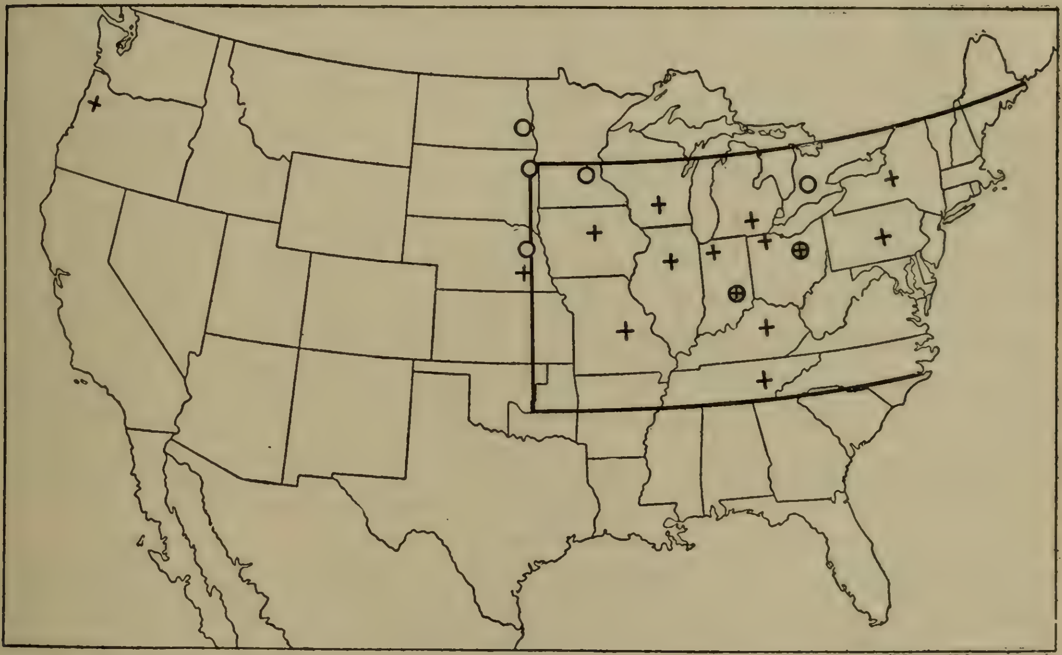


FIG. 1.—Map of the United States, showing locations of experiments (o), sources of seed (+), and general boundaries of the clover region.

attended with success. Furthermore, excellent growth is obtained in a few regions immediately adjoining this area, and there are also several sections wholly separated from it where clover is grown with notable success. Among the latter may be mentioned the Willamette Valley of Oregon, the Palouse country in eastern Washington, and also the Gallatin Valley of Montana, where red clover is being successfully and profitably grown under irrigation.

A lack of definite information has for a long time existed as to the exact life history requirements of red clover, the effect and importance of change of seed, and the relative seed and hay producing properties of the different varieties in use. It was to add to the sum of our knowledge on these and other points connected with clover culture that the present experiments were instituted.

THE IMPORTANCE OF CLOVER CULTURE.

The extraordinary importance of clover in renewing and maintaining the fertility of the soil has been amply demonstrated by the experience of thousands of American farmers and need not be dealt with to any length in this connection. It is sufficient to say that the thoroughly systematic and careful studies of recent years have proved conclusively that the beneficent effects of clover on the soil are due to definite symbiotic relationships which exist between the plant and certain bacteria inhabiting both the soil and the roots of the plants. Nitrogen, at once the most important and costly of plant and animal foods, is the element conserved in the soil or supplied from the air as the consequence of this relationship.

The need for broader knowledge concerning a plant of such vital importance to our present methods of agricultural practice is especially great just now when the status of clover culture in a large part of the clover region is so unsatisfactory. In those sections where the troubles attributed to "clover sickness" exist in an aggravated form, they threaten to make necessary new methods of agricultural practice in order to maintain farming on its present paying basis. Under the methods of farming now in vogue, red clover possesses the valuable manurial properties previously referred to in a higher degree of availability than any other leguminous crop plant at present capable of growth on a scale extensive enough to accomplish what is demanded in this direction in the large area suited to its cultivation.

These conditions make it seem advisable to place immediately at the disposal of the American farmer any facts likely to contribute to greater success in clover culture in its present well-defined area or to aid in its extension into sections where hitherto its culture has not been attempted or, if attempted, has been attended with only qualified success.

DOMESTIC VERSUS FOREIGN SEED.

The opinion has hitherto prevailed that the use of red clover seed from European sources would prove unsatisfactory and unprofitable in this country, both from a hay and seed producing standpoint. This conclusion no doubt applies correctly to the majority of European varieties of red clover, particularly those from Italy, France, and some parts of Germany, which appear to be altogether unsuited to the soil and climatic conditions of the clover-growing area of the United States.

The term "European clover seed" as used in the United States is a very loose inclusive one applied indiscriminately to all seed imported into this country from European ports. It includes not only seed grown in Europe, but also seed from South America, Canada, and the United States itself, the seed having been exported in years when the crop was large and prices consequently low only to be shipped back again to this country in years when the balance of supply and demand had shifted in the opposite direction. Inasmuch as red clover is grown to a large extent in almost all the countries of Europe and quite careful distinctions are made there between seed from a number of sources, the general designation of "European clover seed" hitherto used in this country appears altogether unwarranted and misleading. The same erroneous classification of American red clover seed is current in Europe, no distinction being made whether from New York, Tennessee, or Oregon. The following are some of the numerous regional varieties commercially well recognized in Europe: Steiermark, English, Bohemian, Russian, Danish, Swedish, and French. Some of these are again divided into early and late varieties; for example, Early Russian and Late Russian.

OBJECTIONS OF EUROPEAN GROWERS TO AMERICAN RED CLOVER.

One of the most frequent complaints made by European growers against American clover seed is on account of the dustiness of the hay produced from this seed. This dustiness is due almost wholly to the hairiness of the plant. That there is a great difference in this respect between the hairy domestic and smooth foreign types is strikingly shown in Plate II, figs. 1 and 2. The hairy form of plant shown was produced from American commercial seed, while the smooth one is a promising Russian clover from the government of Orel, designated as No. 16. This difference in hairiness is accompanied by other distinctions, the most important of which from an economic standpoint is the much greater succulence of the smooth plants and the consequently finer quality of the hay, the loss due to coarse, woody, uneatable stems being reduced to almost nothing.

HAIRY CLOVER A CAUSE OF BLOATING.

Cattle are less liable to tympanites, bloating, or hoven, if fed on the hairless Orel clover, as there is considerable evidence to prove that the hairs of the hairy varieties of clover become aggregated into balls in the rumen, and these may reach and block the pylorus or even the entrance to the stomach, becoming wedged between the lips of the esophageal groove. Either would tend to bring on bloating, which is always directly due to the fermentation of food material and the resulting formation and accumulation of gas.

That cattle prefer the smooth form to the American strains is undoubted. Mr. John P. Young, in cooperation with whom the experiments in Nebraska were conducted, states in a recent report that "the cattle fairly lick after every spear in one end of the rick for that Russian strain (No. 16), while the other end remains full of apparently just as good hay, put up at the same time and in the same way." (See Pl. I, figs. 1 and 2.)

SOME GENERAL OBJECTIONS TO THE GROWING OF CLOVER.

Two great objections have long been made against red clover culture in the area where it can be grown. One is that the hay crop matures at a time when the farmer's best interests demand that he be either cultivating his corn or harvesting his small grains. The other is involved in the fact that perhaps the most satisfactory, or at least the most popular method of seeding clover for hay or pasture is in mixtures containing either one or several of a number of grasses, including timothy, bluegrass, rye-grass, orchard grass, redtop, brome-grass, and others. Of these the most important by far is the clover-timothy mixture, and against this it has ever been argued that the clover matures so much in advance of the timothy that the feeding value of either the one or the other is sacrificed on account of the time of harvesting. This serious objection can be overcome in either one of two ways—the discovery or breeding of an earlier strain of timothy or of a later variety of clover.

Another objection to clover growing which is not infrequently heard is that the crop matures at a time in June when seasons of rainy weather are of frequent occurrence, making difficult or impossible the proper harvesting and curing of the crop, while beginning with the latter part of June rainy weather is much less common, conducing to the successful putting up of hay at this time. A cursory examination of the weather records of a number of States seems to indicate that there may be some ground for this objection.

CERTAIN OBJECTIONS OVERCOME BY NEW TYPE OF CLOVER.

The hairless Orel clover overcomes in an effectual way all the objections cited by maturing practically two weeks later than the domestic strains of medium red clover. This factor is of special importance in sections where corn is the chief crop. At the time when a farmer is compelled to put up his clover hay grown from the ordinary strains of seed it is, as a rule, of the highest importance that he be concentrating all of his energies on the cultivation of his cornfields. The corn is rapidly approaching a stage when it becomes difficult or impracticable to cultivate longer. Inability to give the crop the necessary care at this time may mean hundreds of dollars of loss in a single year.

DISADVANTAGE OF LATENESS OF MATURING UNDER SOME CONDITIONS.

There is one drawback in the lateness of maturing of the Orel strain of clover, namely, that it militates against the production of a heavy second crop. However, in southern Indiana, in a typical part of the clover section, the Kief and Orel strains gave in the order mentioned the best yields of seed after recleaning. This is a point that will receive further investigation to determine as accurately as possible by a study of their limiting conditions the regions in which the new variety can be profitably grown.

HEAVY YIELD OF FIRST CROP AND ACCRUING ADVANTAGES.

The heavy yield of the first cutting of the hairless clover should prove indirectly advantageous in wheat-growing sections, especially in the winter-wheat belt, when it is desired to hasten the rotation back to wheat, as the increased product from this cutting would, where feed production was not a paramount necessity, in a measure justify the immediate or early plowing up of the field preparatory to reseeding to wheat. On account of the dense shade which this strain gives to the soil by virtue of its heavy growth, the field is left in unusually fine physical condition for plowing up after the removal of the first crop. A rotation practice of this kind might also prove valuable by postponing for several years the clover sickness from which all soils seem destined to suffer sooner or later. In the Dakotas and some other parts of the Northwest where fall plowing is necessary this method may be especially useful on account of the fact that as freezing up occurs so soon after the maturing of the second crop it is likely to be too late to prepare the land in the autumn for spring seeding.

OTHER POINTS OF EXCELLENCE OF HAIRLESS CLOVER.

In addition to the advantage of the smooth clover already mentioned—its exceptionally large yielding power for the first crop—the fine quality and dustlessness of its hay also command attention. In reference to its yielding qualities it will be seen later on that under comparable conditions in a number of different States it has outyielded from a few hundred pounds to almost two tons all of the domestic strains that have been under test. This in itself is of great importance, but the actual gain in value is not adequately covered by this fact alone. On account of the succulence of the plants of this promising variety, the general quality and texture of the hay is so much finer that the percentage of waste, due to refusal of animals to eat hard, woody portions, is reduced to a minimum. Some observations on this point indicate that cattle waste from 5 to 10 per cent more of the coarse hay of other strains than of this hairless clover. The American strains vary considerably among themselves in this regard, but none of them compares favorably with either the Orel or Mogileff strains, particularly the former.

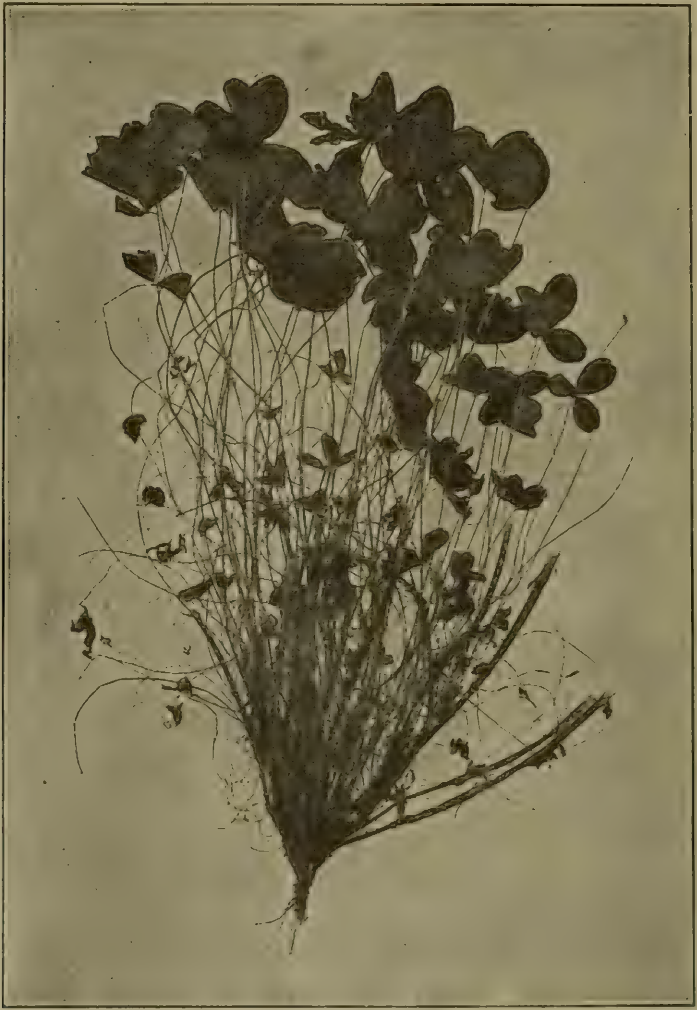


FIG. 2.—Plant of *Trifolium pratense* var. *foliosum*, showing persisting basal leaves. (One-sixth natural size.)

EFFECT OF PERSISTING BASAL LEAVES ON QUALITY OF HAY.

A point of considerable importance as regards the excellence of the hay produced by the hairless Orel clover No. 16 rests in the fact that it leafs much more profusely than the American forms. This may be seen by reference to the frontispiece (Pl. I, figs. 1 and 2).

Another feature in this connection, which is better illustrated than described, is shown in figure 2. Many leaves borne on the long stalks arising from short stems near the crown of the root persist in a growing condition until the plant is quite mature, and are cut with the hay. In the specimen from which the illustration was made the main stems were cut off, leaving only the basal leaves. Much of the leafiness observable in Plate I, figure 1, is due to the persistence of these leaves. Compared with that from American strains, a large percentage of the hay is made up of this tender leafy material, which improves its quality and increases its palatability. The American strains also produce these leaves, but not in such profusion, nor do they persist. (See Pl. I, fig. 2.) As a rule they become brown and dead, and if the weather be wet, decayed, and almost all fall off before the hay is made.

It is hoped that the smooth Orel clover will prove of permanent value especially in North Dakota and South Dakota, where clover culture is but little practiced and where on account of the waning productiveness of the soil, due to continuous cropping with wheat and other cereals, this crop is much needed for renewing and maintaining soil fertility.

LATENESS OF HAIRLESS CLOVER WITH REFERENCE TO INSECT RAVAGES.

A recent circular[a] prepared by the Bureau of Entomology calls attention to certain insects which destroy the clover seed crop and suggests as a method of preventing their ravages the clipping of the clover in May in order to cause blossoming to come on at a later date, when the danger from injury by these insects has passed. It is possible that the natural lateness of this new type of clover may accomplish this same result, thus doing away with the necessity for early clipping, which would probably make impossible the securing of more than one crop in any year.

A point of considerable interest and importance in reference to the general question of the harm done by insects was noted on the plants at Wapakoneta, Ohio. Grasshoppers were quite numerous and destructive in that section during the summer of 1905. The hairless Orel clover, known as No. 16, was not included in the experiment, but another smooth type from Kief, Russia, was tested at this place. It was found that the grasshoppers preferred the hairless clover to such an extent that they destroyed almost every plant of it, but did not molest the hairy American plants on the neighboring plats.

---

[a] "Some Insects Affecting the Production of Red Clover Seed." By F. M. Webster. Circular 69, Bureau of Entomology, U. S. Department of Agriculture, 1906.

Despite the numerous advantages possessed by this variety, it is not believed that it will supplant our domestic form, but rather, on account of its maturing between two cuttings of the latter, supplement it, especially when continuous green feeding is necessary or desirable.

EFFECT OF LATENESS OF MATURING WHEN SEED PRODUCTION IS DESIRED.

In many sections the lateness of this hairless strain of clover promises to be a drawback when it comes to seed production, as in years when it is desired to secure seed it may be possible to secure only either a light crop of hay from an early cutting, a small aftermath, or a considerable amount of pasturage.

SECTIONS PARTICULARLY SUITED TO THE CULTIVATION OF THE NEW TYPE.

In such a region as the Willamette Valley of Oregon, or in any other section where the best methods of management indicate that only one crop, either of hay or seed, and a light aftermath, or some good pasturage can be advantageously expected from clover fields, the extraordinarily heavy first crop, and the free seeding capacity of the late hairless clover make it especially desirable; and under such circumstances as these it can be recommended to take the place of our domestic form.

SEED OF NEW TYPE INDISTINGUISHABLE FROM ORDINARY FORM.

Another difficult, though not insurmountable, obstacle to the general use of this variety lies in the fact that the seed itself is indistinguishable from that in common use. However, as soon as there is a supply of seed and a demand for it, trustworthy dealers will no doubt furnish seed upon which dependence may be placed. The Department of Agriculture has at the present time only sufficient seed of this variety for experimental purposes and none for general distribution. Farmers purchasing seed from foreign sources purporting to be of the same kind are urged to take precautions against allowing any foreign weed pests that may be readily imported with the seed to gain a foothold in their fields. A number of the State experiment stations and the Seed Laboratory of this Department make purity and germination tests without charge; hence, a farmer before purchasing seed should avail of these facilities for insuring himself against introducing into his farm dangerous weeds or from buying seed of low germinating power.

In the following pages are given in detail the data concerning each of the strains experimented upon, special attention being given to the hairless Orel clover.

PLANS OF EXPERIMENTS, ORIGIN OF SEED, AND METHODS OF PROCEDURE.

For the present experiments about thirty regional varieties [a] of red clover seed were secured from as many domestic and foreign sources. Each station and individual cooperator has been furnished with a series including from 16 to 21 of these strains, and these are being grown side by side, in most cases on acre plats, under as nearly uniform conditions as possible. The varieties came from sources having a great diversity of climatic and soil conditions and methods of cultivation, and are now being grown under a range of conditions representing scarcely less diversity than those under which they originated. Twenty States are represented in the whole experiment, but of this number it is proposed to deal here only with those localities where the promising Russian variety before mentioned is being grown: Minnesota, North Dakota, South Dakota, Nebraska, Indiana, Ohio, and Ontario.

The circles on the sketch map of the United States (fig. 1) show the approximate location of each of the stations, while the crosses indicate the general region of each State from which the strains of known American origin were secured.

In the case of domestic varieties, every effort was made to secure seed that had been grown in the region of origin for a period of years and whose ancestry could as a consequence be followed to some extent. In most instances the American strains used are directly traceable to the identical field which produced them, and soil samples have been secured for examination and comparison with the soils into which they were transplanted. In the present bulletin only those varieties grown in comparison with clover No. 16, the promising Russian variety, will be discussed. All of the seed used in the work was secured by the Office of Seed and Plant Introduction and Distribution, the foreign seed through Dr. E. A. Bessey and that of home-grown varieties through the writer.

---

[a] The term "variety" is not used in its strict botanical significance, but is employed to designate seed from more or less widely separated sources.

The following table shows the region of origin of each strain grown in the different localities:[a]

TABLE I.—*Source of clover seed used in experiments and the localities in which it was tested.*

Source of seed.	Where tested. Nebraska.	South Dakota.	Minnesota.	North Dakota.	Indiana.	Ohio.	Ontario, Canada.
1. Commercial seed (Western Bulked)	+	+	+	+	—	+	+
2. Western Ohio	+	+	+	+	+	+	+
3. Northern Indiana	+	+	+	+	+	+	+
4. Southern Indiana	+	+	+	+	—	+	+
5. Illinois	+	+	+	+	+	+	+
6. Missouri	+	+	+	+	—	+	+
7. Iowa	+	+	+	+	—	+	+
8. Commercial seed (not inoculated)	+	+	+	+	+	+	+
9. Commercial seed (inoculated)	+	+	+	+	+	+	+
10. Michigan	+	+	+	+	+	+	+
11. Nebraska	+	+	+	+	+	+	+
12. Eastern Ohio	+	+	+	+	+	—	+
13. Kentucky	+	+	+	+	+	+	+
14. Tennessee	+	+	+	+	+	+	+
15. Kief, Russia	+	+	+	+	+	+	+
16. Orel, Russia	+	+	+	+	+	+	+
17. Mogileff, Russia	+	+	+	+	—	+	+
18. Courland, Russia	+	+	+	—	—	+	+
19. Wisconsin	+	+	+	+	—	—	+
20. Oregon	+	+	+	+	+	—	+
21. Pennsylvania	+	—	+	—	+	—	+
22. New York	—	+	—	—	—	—	+

SOURCES OF RUSSIAN CLOVER SEED EXCEPT NO. 16.

Four Russian varieties were included in that part of the experiment under discussion, but, as may be seen by reference to Table I, not all of these were included in the series tested in each of the six States. Russian seed No. 15 was purchased in the open market under the trade name "Russian Rio." This seed was grown in the Province of Kief, in southwestern Russia, and, in common with all other strains used in this test, is of the crop of 1903. Seed from this same region, but of a previous crop, made a particularly good showing in Wisconsin in 1903, producing a plant that appeared to possess several excellent qualities not common to our own domestic strains. On this account a special effort was made to include a sample of this seed in these comparative experiments. Its productiveness and quality in 1903 were fully equaled in 1905, and but for the superior performance of No. 16, with which it has many points in common, it might well be recommended for use in the Northwest and elsewhere to take the place of our domestic strains. It has in all cases proved to be, like No. 17, intermediate in lateness of maturity, being later than No. 18

---

[a] The minus sign indicates that the strain opposite which it occurs was omitted from the series grown in the State specified.

and all the American strains, but earlier than No. 16, to which later experiments may show it to be superior under certain climatic and soil conditions.

Of the other three Russian varieties, Nos. 17 and 18 were secured from the following sources: No. 17 (S. P. I. No. 10533) was grown by M. Legsdin, near Shlobin (52° 50′ N., 30° E.) in the valley of the Dnieper, in the southern part of the Mogileff government, and was purchased from Mr. Heinrich Goegginger, of Riga. No. 18 (S. P. I. No. 10534) was obtained through Fr. Lassman, of Riga, and was produced near Neuhof (24° 35′ E., 56° 53′ N.), in the Baltic Province of Courland, on the estate of M. Sellin.

SOURCE FROM WHICH RUSSIAN SEED NO. 16 WAS OBTAINED.

The seed of the promising hairless clover No. 16 (S. P. I. No. 10532), to which it is desired to call special attention, was obtained by Dr. E. A. Bessey through H. Goegginger, of Riga, and was produced on the estate of a German grower near Yeletz, in the eastern part of the Orel government. The grower made a practice of saving his own seed, and hence this strain had been grown on the same estate for a number of years.

According to Mr. Goegginger, the government of Orel furnishes the best red clover seed obtainable in Russia. Its chief crops are winter rye and oats, and it is in rotation with these that the clover is grown. A small quantity of winter wheat is also grown.

THE SOIL AND CLIMATE OF OREL.

Yeletz is situated about longitude 38° E. and latitude 52° N., and lies well within the famous "Black Earth" or Tchernozom region of Russia. This region, comprising about 250,000,000 acres of the most fertile soil in the world, resembles strikingly in many features of both soil and climate our own Great Plains region. According to Sibirtzew [a] the Tchernozom extends from the Austrian and Roumanian frontier in a general east by northeast direction, forming a great band, varying in width from 250 to 650 miles, across the whole empire. The climate of this wonderfully fertile area is typically continental. The average mean annual rainfall of this region varies ordinarily between 16 and 22 inches and the temperature ranges from 30° F. or more below to more than 100° F. above zero.

According to Murchison, Verneuil, and Keyserling,[b] the black soil of the eastern part of the Orel government is especially rich in marl and limestone. In the light of our knowledge on the general beneficial effects of liming, it appears altogether probable that this factor may contribute to a considerable extent to the success of clover growing in this area.

---

[a] Etude des Sols de la Russie. Compte Rendu Congrès Géologique International, St. Petersburg, 1899, pp. 73–125.

[b] The Geology of Russia in Europe and the Ural Mountains, London, 1846, Vol. II, pl. 6.

Orel occupies an elevated position in comparison with the governments which border it on the south; on this account its climate resembles more strikingly that of the states that bound it on the north. Its relatively high altitude, exposing it completely to the winds, is the cause of the more or less sudden changes in temperature to which this area is subject. These changes are induced by the warm winds which come from the south, southeast, and east, and by the cold winds from the north, northwest, and west. The mean annual temperature at Orel, the nearest point to Yeletz for which complete meteorological observations could be found, is 40.9° F. The seasonal means are as follows: Spring, 38.48° F.; summer, 66.11° F; autumn, 43.08° F.; winter, 15.08° F. The absolute maximum temperature thus far observed is 97.5° F., while the absolute minimum is $-29.2°$ F. An average for a period of years shows 107 clear days, 127 with rain or snow, and 131 variable. The normal annual precipitation is 20.2 inches. The rivers of the Orel government are covered with ice on an average for 119 days during the year—from the first part of December until early in April. The climate will thus be seen to be a relatively temperate, continental one, resembling that of central Russia in general, but having somewhat more variable atmospheric conditions which often prove unfavorable to agriculture. Devastating storms are not infrequent in summer, while snowfalls accompanied or followed by high winds are common in winter.

From this brief characterization of the climatic conditions of the region from which Russian seed No. 16 was obtained, its likeness to that of our own northwestern prairie country can be easily seen, and added reasons for the promise of this strain of red clover in the Northwest are readily discernible. A beneficial change of seed has been accomplished between two regions having typically similar climatic conditions and soils that are singularly alike both in mechanical structure and chemical composition. The presence in both of a relatively large quantity of lime in a perfectly combined state is perhaps one of the most important similarities between these two widely separated soil areas.

The following table summarizes the more salient climatic features of Orel and the regions of America where clover No. 16 has already been grown and where, on the basis of the showing made in the growing season of 1905, the best results may be expected from its future cultivation:

TABLE 11.—*Temperature and rainfall of Orel, Russia, and certain localities in America.*

Location.	Temperature.						Precipitation.	
	Mean annual temperature.	Normal mean for January.	Normal mean for July.	Mean temperature of growing season.	Absolute minimum.	Absolute maximum.	Normal annual rainfall.	Normal rainfall of growing season
	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	*Inches.*	*Inches.*
Orel	40.4	13.4	66.8	61.59	−29.2	97.5	20.2	10.62
St. Paul, Minn. [a]	43.3	10.6	71.5	65.02	−41	104	26.99	17.39
Milbank, S. Dak. [b]	43	13.1	70.5	65.1	−34	107	20.73	13.73
Fargo, N. Dak.	38.7	5.4	68	62.5	−48	102	20.83	13.66
Tekamah, Nebr. [c]	49.2	22.7	75.3	68.7	−24	106	31.98	22.90
Guelph, Ontario	42.05	16.9	68	60	....	....	28.48	12.80

[a] St. Anthony Park, where these experiments were conducted, lies about midway between St. Paul and Minneapolis, Minn.

[b] No meteorological data are available for Bigstone, S. Dak.; hence the observations for Milbank, a point 11 miles distant, are here given.

[c] No meteorological data being available in the case of Oakland, Nebr., the records of Tekamah, a point 16 miles distant, are used.

PURITY AND GERMINATION OF SEED USED IN EXPERIMENTS.

In purchasing the different lots of seed used in the work, the greatest care was exercised to secure samples as free as possible from troublesome and injurious weeds, particular care being used with reference to dodder. All of the seed was of high average quality both as to purity and germination. The average purity of all samples as distributed for seeding was 98.13 per cent. As may be seen by an inspection of the following table, the seed showing the highest percentage of purity was that from Oregon, containing 99.68 per cent of pure seed, while the seed grown in New York contained the highest percentage of impurities, 7.46 per cent, or 92.54 per cent of pure seed. Every sample was screened from two to six times, one even twelve times, in order to remove as many of the impurities as possible.

The average germination of all samples was 87.07 per cent, the lowest percentage being 58.2 per cent for the seed from Courland, Russia; the highest, 99.12 per cent for the seed from eastern Ohio. Red clover seed germinating from 90 per cent to 95 per cent is generally considered as representing a satisfactory commercial product.

TABLE III.—*Purity and germination of red clover seed distributed in the spring of 1904.*

No.	Source of seed.	Purity.	Germination.
		Per cent.	*Per cent.*
1	Commercial seed (Western Bulked)	99. 58	94. 25
2	Western Ohio	98. 42	75. 62
3	Northern Indiana	97. 7	88. 2
4	Southern Indiana	98	94
5	Illinois	99	92. 87
6	Missouri	96. 8	88. 27
7	Iowa	98. 4	82. 75
8	Commercial seed (not inoculated)	99. 28	95. 25
9	Commercial seed (inoculated)	99. 28	95. 1
10	Michigan	99. 58	94. 62
11	Nebraska	96. 66	85. 37
12	Eastern Ohio	99. 56	99. 12
13	Kentucky	99. 48	73. 87
14	Tennessee	97. 98	92. 5
15	Kief, Russia	98. 4	86. 75
16	Orel, Russia	95. 5	87. 87
17	Mogileff, Russia	98. 34	91
18	Courland, Russia	97. 62	58. 2
19	Wisconsin	98. 6	84. 7
20	Oregon	99. 68	91. 51
21	Pennsylvania	97. 58	91
22	New York	92. 54	92. 57

DETAILED DESCRIPTION OF EXPERIMENTS.

As previously stated, all of the seed used in these experiments was produced in the crop year 1903 and all of the experimental areas under discussion were sown in the spring of 1904. The observations made in each State will be discussed separately.

THE EXPERIMENT IN NEBRASKA.

LOCATION.

The work in Nebraska was carried on in cooperation with Mr. John P. Young, on his farm near Oakland, Burt County. This place is situated at about latitude 41° 50′ N. and longitude 96° 26′ W., in the Elkhorn Valley, near the present western limit of successful clover culture.

SOIL.

With the exception of a streak of limited extent, where the subsoil crops out, the soil of the clover field is a silted sandy loam of dark gray color and of such structure that with insufficient moisture it becomes aggregated into a hard, almost impenetrable mass. After rains it becomes very plastic and tenacious, very much resembling clay in this respect. On account of this character a large part of the soil of the Elkhorn Valley has become known under the name "clayland." This soil is further distinguished by a comparatively large percentage of well-distributed calcareous matter. This is a factor of great importance to successful clover culture, and no doubt helps to account for some of the heavy yields obtained in this soil.

DRAINAGE.

On account of a moderate slope in two directions the drainage of the experimental plats is excellent, none of them being so situated as to be in danger of suffering injury on account of standing water. The field contains 21 acres and was divided into as many equal parts, one being devoted to each of the regional varieties under test. In 1902 the field bore a crop of oats and in 1903 of corn.

PREPARATION OF LAND AND SEEDING.

In preparing the seed bed for the clover, the land was double disked with a pulverizing machine and well leveled with a common harrow. Oats were used as a nurse crop, one half of all plats being sown to the Early Champion variety, the other half to the Kherson oats, a variety of Russian origin that has proved exceedingly valuable in Nebraska. The oat crop was harvested just after the middle of July, the Kherson variety yielding 35 and the Early Champion 25 bushels to the acre.

The clover was sown at the same time as the oats. Seeding began on April 15, but on account of unavoidable delays due to inclement weather was not completed until April 21. The seed was sown at the rate of 10 pounds to the acre, and by April 25 seedling plants had appeared on all the plats. After July 23, when the removal of the oat crop was completed, the clover had the whole use of the land. By the time for the cutting of the oats the clover had made a sufficient growth to be slightly clipped by the harvesting machine. Except for a light pasture with calves in November no further treatment was given the crop during the growing season of 1904

GENERAL WEATHER CONDITIONS DURING 1904.

The general condition of the weather throughout the season was favorable to securing a good "catch" of clover. There was plenty of rainfall during the season as a whole and no extended or injurious periods of drought occurred, although during September the dryness was sufficient to cause the soil to become very hard, as is characteristic of it when even moderately dry conditions prevail long enough.

COMPARISON OF STRAINS OF CLOVER ON ENTERING THE WINTER OF 1904.

According to notes taken by Mr. Young about the middle of November, 1904, there was a great degree of diversity in the general thriftiness of the various strains of clover when they entered the winter. In view of the data secured in 1905 the fact that the Iowa plat represented the normal or mean condition of all plats, the Nebraska strain standing next below it, is significant. In the data for the crop year 1905, given in Table VI, it will be noted that Nebraska seed gave the lowest yield and Iowa seed next to the lowest. Taking Iowa as representing the average condition, the departure of each of the strains from the average is shown by the following table:

TABLE IV.—*Comparison of stand obtained from seed from various localities on plats at Oakland, Nebr., autumn of 1904.*

Above normal.			Normal.		Below normal.		
No.	Source of seed.	Rank.	No.	Source of seed.	No.	Source of seed.	Rank.
20	Oregon	1	7	Iowa.	11	Nebraska	1
5	Illinois	2			8	Commercial seed (not inoculated).	2
2	Western Ohio	3			9	Commercial seed (inoculated).	3
12	Eastern Ohio	4			15	Kief, Russia	4
19	Wisconsin	5			16	Orel, Russia	5
10	Michigan	6			17	Mogileff, Russia	6
21	Pennsylvania	7			18	Courland, Russia	7
3	Northern Indiana	8					
4	Southern Indiana	9					
14	Tennessee	10					
6	Missouri	11					
13	Kentucky	12					

This table shows that when winter set in in 1904 the plats sown to Kentucky, Missouri, and Tennessee seed were the most promising, in the order given. Two of those ranking below normal proved to be the best when the hay was harvested in 1905. These were the Orel clover No. 16 and the inoculated trade sample.

According to notes taken by Mr. Young, the plants produced by seed No. 16 were at this time "the weakest, most delicate, and farthest below normal" of any of the varieties included in the experiment. In view of the fact that in 1905 this clover outyielded the best of all the others by more than 1,000 pounds, this note is of unusual interest. Mr. Young further states that "it resembles somewhat the common white clover, only the plants are larger; but the leaves have that same appearance and are smaller than those on any of the other plats."

The winter of 1904–5 was quite severe, with temperatures reaching as low as 30° F. below zero. There were some days whose maximum only reached −20° F. However, as there was an abundance of snow the clover plants on all plats were adequately protected, and there was apparently no loss due to winterkilling. Without exception the plats were in excellent condition in the spring of 1905.

COMPARISON OF EARLY GROWTH OF CERTAIN STRAINS OF CLOVER.

By May 10 the different strains of clover had made average growths varying from 1 to 5 inches. The plat sown with Missouri seed showed the greatest average growth, while the Russian seed No. 18, from the Baltic Province of Courland, grew the least. The former had an average height of from 4 to 5 inches; the latter, from 1 to 2 inches. Despite this great discrepancy in early growth, the Russian strain was in bloom almost as soon as the Missouri strain and was ready for harvest in advance of it. The hay crop of the former was cut on June 20; that of the latter, June 21. Unlike the Baltic strain, the Orel clover was the latest of all in coming into bloom, as well as the latest in coming to proper maturity for harvesting. It was harvested on July 11. It will be seen from this that a period of exactly three weeks elapsed between the date of cutting of the earliest and the latest strains. This fact is of direct importance under some conditions, as will be pointed out later.

WEATHER DURING GROWING SEASON OF 1905.

The weather during those months of the growing season preceding the cutting of the hay crop was in all respects favorable. The growth of the clover began in March, which month had a mean temperature of 44.8° F., more than 8.4 degrees below the normal. The mean temperature for April was 48.4° F., which is 3.2 degrees below the normal for that month. The precipitation aggregated more than 5 inches, 2 inches above normal. The temperature for May, 58.9° F., was 2.4 degrees cooler than the established normal for that month, while the precipitation, 4.76 inches, was practically normal. The June temperature of 70° F. was very near the normal, but the rainfall for that month, 2.75 inches, was more than 3 inches less than normal. None of the plats seemed to have suffered any injury despite the seeming dryness of the month. In July again the temperature was normal, while the rainfall was about 2 inches below normal.

EARLINESS OF VARIETIES AND ORDER IN WHICH THEY MATURED.

On account of their reaching maturity at practically the same time, the strains were harvested in the following groups. The varieties in each group are arranged as nearly as possible in the order of their earliness. The groups themselves are given in the same order, the earliest being first:

Group I.—Courland, Russia; Nebraska; Pennsylvania.
Group II.—Missouri; Iowa; Kentucky; Wisconsin.
Group III.—Eastern Ohio; Oregon.
Group IV.—Tennessee; Kief, Russia.
Group V.—Illinois; northern Indiana; Michigan; southern Indiana; northwestern Ohio.
Group VI.—The commercial samples, Nos. 1, 8, and 9; Mogileff, Russia; Orel, Russia.

Despite the fact that the earliest and latest maturing kinds are of Russian origin, it will be noted that the American strains present almost as great diversity in this regard. However, leaving out of consideration the commercial samples whose region of origin is unknown, the latest of the American strains of known origin is that from northern Ohio, which was grown west of Toledo near the northern boundary of the State. This strain came into bloom only nine days later than the earliest of the American kinds, that from Nebraska. It will be seen from this that the range of maturing time of the American strains that are traceable to their region of origin as compared with the Russian varieties is very short indeed.

The table given below shows the date of full bloom of the earliest and latest American and Russian varieties:

TABLE V.—*Date of full bloom of earliest and latest American and Russian strains of clover.*

Earliest Russian.		Earliest American.		Latest American.		Latest Russian.	
Source.	Date.	Source.	Date.	Source.	Date.	Source.	Date.
Courland	June 20	Nebraska	June 20	Western Ohio.	June 29	Orel	July 11

Concerning the commercial samples used, it should be said that they were of most unusual purity, as well as of high average germination. The seed itself was very large and of a deep purple color, while the plants produced were coarse and hairy. This form seems to stand intermediate between the medium red, with which this experiment deals, and the well-known "mammoth" form of *Trifolium pratense*, which it resembles in some respects. Nothing is known as to the origin of this seed further than that it is supposed to have been produced in the Middle West. It came into full bloom on July 6, seven days later than the latest of American strains of known origin, and five days earlier than No. 16, the hairless form from Orel.

On account of the coarse, woody stems of the Western Bulked clover, there is a large percentage of waste in feeding its hay, the cattle refusing to clean it up as they do some of the other strains, notably No. 16. On account of the excessive hairiness of both stems and leaves the hay is very dusty, and hence not a pleasant and desirable feed.

The hay product of each of the different plats is shown by the following table:

TABLE VI.—*Comparison of yields of hay of regional varieties of red clover at Oakland, Nebr., in 1905.*[a]

No.	Source of seed.	Yield of hay.	No.	Source of seed.	Yield of hay.
		Pounds.			*Pounds.*
1	Commercial seed (Western Bulked)	5,700	12	Eastern Ohio	5,080
2	Western Ohio	4,980	13	Kentucky	5,540
3	Northern Indiana	4,780	14	Tennessee	4,670
4	Southern Indiana	5,020	15	Kief, Russia	5,840
5	Illinois	4,990	16	Orel, Russia	7,100
6	Missouri	5,010	17	Mogileff, Russia	5,750
7	Iowa	3,950	18	Courland, Russia	4,750
8	Commercial seed (not inoculated)	5,750	19	Wisconsin	4,950
9	Commercial seed (inoculated)	6,040	20	Oregon	4,930
10	Michigan	5,570	21	Pennsylvania	4,460
11	Nebraska	3,590			

[a] On account of a misunderstanding, the plats were not sown in serial order as given, but as follows: 11, 7, 1, 9, 8, 20, 10, 5, 3, 4, 2, 12, 19, 6, 13, 14, 15, 16, 17, 18, 21.

The first crop only was harvested for hay, the second being left to go to seed. The seed production of the various strains will be made the subject of further study.

The product of the plats sown with Western Bulked, Illinois, Iowa, Michigan, Nebraska, and Oregon seed was slightly reduced by a streak of subsoil which cropped out in these plats and on which the stand was not so perfect as on the other parts of the field. The resulting difference would amount to but a small percentage and would not modify materially the results as tabulated.

The Missouri plat was slightly injured in the spring by the work of ground moles, but seemed to have fully recovered from the injury before the cutting of the hay crop.

The only plat upon which any dodder appeared was that sown with the seed from Tennessee. It was promptly subdued and practically no harm resulted from it.

Although it would be unsafe to generalize from the results of one year's observation, it is interesting to note the fact that the seed produced in Nebraska and Iowa gave the lowest yields. This may be partially explained by the inferiority of the stand caused by the clay streak referred to above. However, it appears to the writer that this explanation is inadequate in view of the fact that the commercial samples which were grown on adjoining plats show no corresponding reductions in yield. As noted above, the Michigan, Illinois, and Oregon plats were crossed by the same streak of clayey subsoil.

YIELD OF THE OREL CLOVER COMPARED WITH OTHER STRAINS.

The total yield of all plats was 108,220 pounds, or about 54.1 tons. The highest yield was that of the hairless Orel clover, 7,100 pounds per acre; the lowest was from the Nebraska seed, 3,590 pounds, while the average for all plats was 5,153 pounds. It is interesting to note that three of the four Russian strains yielded considerably above the average for all plats.

The Orel clover No. 16 yielded 3,510 pounds of hay to the acre more than the Nebraska clover, giving a product almost double that of the latter. It produced more than 1,000 pounds more than its nearest competitor, one of the commercial samples, and almost a ton above the average for all plats.

THE EXPERIMENT IN SOUTH DAKOTA.

LOCATION.

The work for South Dakota is being carried on in cooperation with Flam Brothers on their farm near Bigstone, Grant County. Bigstone, which is situated 54° 10′ north latitude, 96° 26′ west longitude, is in the northwestern part of the State. This station represents fairly well the conditions typical of eastern South Dakota and western Minnesota.

As in the case of Nebraska, the experimental plats were each an acre in extent, and the series of 22 varieties used was identical with the one grown in Nebraska, except that seed from New York was added.

SOIL AND DRAINAGE.

The field is a piece of bottom land bordering on a small creek. The soil, which is derived from the washing down of the surrounding prairie upland, is a black, sandy loam. The sand varies from medium to fine. The soil is productive, yielding excellent crops of wheat, oats, barley, corn, and millet. It is quite rich in calcareous matter. No definite rotation of crops including a legume has been practiced, and this is the first time the land has ever borne a crop of clover. On account of the excellent natural drainage due to the permeability of the soil and the elevation above the level of the creek it has not been necessary to resort to artificial drainage on the tract.

PREPARATION OF LAND, SEEDING, AND SUBSEQUENT TREATMENT.

No chemical fertilizers have ever been used on the field. In the spring of 1903 the tract was given a heavy dressing of barnyard manure, which was thoroughly worked in by the preparation given the land and by the cultivating of a corn crop planted that year. In the preceding year, 1902, the tract had grown barley and millet.

In preparation for the clover and the accompanying nurse crop of barley the land was deeply plowed in the fall of 1903, and in the spring of 1904 was harrowed until the seed bed was in suitable condition. The seeding of the barley, which was drilled in, took place during the last days of April. It was harvested in July, the field yielding an average of 50 bushels machine measure to the acre.

The clover was sown broadcast on May 5, and then lightly harrowed in. Before the tenth of the month, the first sprouts had appeared on each of the 22 plats.

After the removal of the nurse crop, no subsequent treatment was given the field during the growing season of 1904. Despite the fact that an unusual growth was made by the clover before wintering in, it was neither clipped nor pastured, on account of the uncertainty as to the effect this would have on the plats coming through the winter. The growth left on the field formed an excellent binder for holding the snow. This gave the plants a good protection from the cold during the winter, which in this latitude is very rigorous.

Observations made in October, about the time of the frost which terminated growth for the season, showed, as in the case of Nebraska, considerable variation in the habit and development of the various plats, but on none of the plats was there any evidence of any failure to secure an excellent stand.

WEATHER CONDITIONS DURING 1904 AND 1905.

The state of the weather throughout the season was exceedingly favorable, there being plenty of moisture at all times. This is a factor of no small importance, especially at the critical period following the removal of the nurse crop. The loss sustained by the various strains on account of winterkilling during the winter of 1904–5 was comparatively small and probably did not reach more than 5 per cent in any case. The Missouri and Tennessee clovers were the worst sufferers in this respect among the American forms. The loss by winterkilling had no perceptible effect on the yield so far as could be observed; at least, the heaviest losers on this account were by no means those giving the lightest yields.

The weather for the months of April, May, June, and July, during which the growth of the hay crop took place, was decidedly abnormal for this section. The mean temperature for each of these months was below normal from 2.5 to 4.6 degrees. The precipitation, as is generally the case in comparatively cool seasons, was far above normal for each of these months, except April, when it fell below normal.

The weather records at Milbank, 11 miles distant, give the following data for these months in 1905:

TABLE VII.—*Temperature and rainfall at Milbank, S. Dak., during the growing season of 1905.*

Month.	Temperature.		Precipitation.	
	Mean for month.	Departure from normal.	Total for month.	Departure from normal.
	° *F.*	° *F.*	*Inches.*	*Inches.*
April	42. 2	−2. 7	1. 25	−0. 96
May	52. 4	−4. 6	7. 35	+4. 50
June	63 1	−2. 5	8. 60	+4. 82
July	67. 4	−3. 1	5. 27	+2. 65

As in the case of Nebraska, there was great variation in the dates of first and full bloom; but inasmuch as careful notes of the actual dates were not kept, through inadvertence, it is impossible to report in detail on these points.

The first sample to come to the proper maturity for harvesting was that from Oregon, followed soon by the New York and Pennsylvania plats. A period of very rainy weather which followed the cutting and curing of these plats made it impossible for a time to proceed with the harvest, and on the night of July 3 came a veritable cloudburst, more than 5 inches of rain falling. The neighboring creek overflowed its banks, inundating the whole bottom and submerging the clover plats with from 6 inches to several feet of water.

This misfortune threatened to make impossible the securing of further data concerning the varieties. However, the excellent drainage of the field saved it from serious injury, and at the end of a week it was possible to proceed with the harvest.

The following table shows the yield of cured hay produced by each of the strains used in the experiment at this place:

Table VIII.—*Comparative yield of hay of various strains of clover at Bigstone, S. Dak., in 1905.*

No.	Source of seed.	Yield of hay.	No.	Source of seed.	Yield of hay.
		Pounds.			*Pounds.*
1	Commercial seed (Western Bulked)	4,400	12	Eastern Ohio	4,640
2	Western Ohio	3,500	13	Kentucky	3,420
3	Northern Indiana	2,510	14	Tennessee	3,970
4	Southern Indiana	2,710	15	Kief, Russia	4,080
5	Illinois	3,990	16	Orel, Russia	5,610
6	Missouri	4,450	17	Mogileff, Russia	4,030
7	Iowa	4,130	18	Courland, Russia	3,280
8	Commercial seed (not inoculated)	3,998	19	Wisconsin	2,970
9	Commercial seed (inoculated)	4,312	20	Oregon	4,560
10	Michigan	4,400	21	Pennsylvania	1,800
11	Nebraska	4,500	22	New York	2,400

COMPARISON OF YIELDS.

The low yields of the samples of clover from western Ohio and northern Indiana are due to the injury they received from the flooding previously mentioned. A "run," or former creek bed, which extended diagonally across these two plats was transformed into a torrent and did considerable damage to both of them. With these exceptions the injury by water was equal on all plats. The comparatively low yield of the New York and Pennsylvania strains may be explained, in part at least, by the fact that the west side of the field, along which these were sown, had not been under cultivation as long as the remainder of the field and hence was not so well subdued.

The total yield of cured hay from the 22 acre plats was 87,982 pounds an average of 3,998 pounds, or nearly 2 tons, to the acre. Leaving out of consideration the plats that suffered from apparent external injuries, the plat sown with Wisconsin seed gave the lowest yield of the domestic varieties, while that sown with seed from eastern Ohio gave the highest yield. The yield of the former was 2,970 pounds, something more than 1,000 pounds below the average for all plats, while that of the latter, 4,640 pounds, was about 650 pounds greater than the average.

As was the case in the experiments at Oakland, Nebr., the hairless Orel clover No. 16 gave not only the heaviest yield among the

Russian strains, but it outyielded every other variety used in the experiment. It produced 5,610 pounds of cured hay to the acre, which is more than three-fourths of a ton (1,612 pounds) better than the average for all plats, almost 1,000 pounds more than the best American strain (that from eastern Ohio), and more than a ton and a quarter (2,640 pounds) more than the lowest yield of the domestic strains growing under like conditions (that from Wisconsin).

In addition to its great yielding power, the other excellent qualities of this strain as observed in Nebraska were reproduced in South Dakota. The marked absence of hairiness on both stems and leaves, the erectness of habit, the profuseness of leafage, the comparative lack of waste on account of hard, woody stems, and a number of other desirable qualities were all strikingly apparent.

THE EXPERIMENT IN MINNESOTA.

LOCATION, SOIL, AND DRAINAGE.

The experiments in Minnesota were carried on on the University farm at St. Anthony Park, with the cooperation of the division of agriculture of the Experiment Station and School of Agriculture. The work here was instituted under the direction of Prof. W. M. Hays, and is now being carried forward with the assistance of Mr. A. D. Wilson, of the station staff. St. Anthony Park is located midway between Minneapolis and St. Paul at about latitude 44° 58′ N. and longitude 93° 90′ W.

In this experiment two series of plats were used on rather widely separated fields. The plats of one series were one-twentieth of an acre in extent, and the product of these was used in determining by weight the amount of green matter produced by each strain. The plats of the other series had an area of one-fourth of an acre each, and were devoted to securing data as to the production of cured hay. According to Hays and Boss[a] both the soil and immediate subsoil of the University farm are of medium texture, containing clay and sand mixed in such proportions as to facilitate a rather free absorption of the rainfall which penetrates to a considerable depth and is well conserved in seasons of moderate drought. At a depth of 5 or 6 feet, however, the mixture of clay and sand gives way to gravel and sand. This furnishes excellent underdrainage in years of abundant or superabundant rainfall, but is a serious drawback in years of drought, as it tends toward the dissipation of a part of the water supply of the crops through this deeper porous subsoil. The surface drainage, as well as the underdrainage, of both areas used in this experiment was excellent.

---

[a] Bulletin No. 62, Agricultural Experiment Station, University of Minnesota, March, 1899.

PREPARATION OF LAND, SEEDING, AND SUBSEQUENT TREATMENT.

Field F, which was used in making the green-matter determinations, was sown to Canada field peas in 1902, and in 1903 was used in the variety testing of cereals. The field was fall-plowed in 1903 and in the spring was disked and harrowed preparatory to seeding with clover. Spelt was used as a nurse crop. The clover seed and the spelt were mixed and sown with a drill.

Field W, from which the data as to field-cured hay was secured, bore a crop of fodder corn in 1902, and was manured and again sown to fodder corn in 1903. In preparation for the clover it was thoroughly disked and harrowed. The clover seed was drilled in to a depth of from 1½ to 2 inches, having been first mixed with the Minnesota No. 169 wheat, which was used as a nurse crop.

No treatment such as pasturing or clipping was given the field after the removal of the spelt and wheat.

WEATHER CONDITIONS DURING 1904 AND 1905.

The weather throughout the season of 1904, despite the fact that the temperature in most months was a little below normal, was quite favorable to securing a good "catch" of clover. The last killing frost in spring occurred on May 15, and the first in autumn on October 6. There was a plentiful supply of moisture at all times, the precipitation of every month during the growing season exceeding the normal.

According to notes taken shortly before the first killing frost of autumn, there was a fair stand on all plats at that time. The weakest strains were those from Tennessee, Orel, and Kief, while among the most vigorous were those from Ohio, Indiana, Wisconsin, and Iowa.

The winter of 1904–5 was rather severe on the whole, the means for both January and February being several degrees below normal. The minimum temperature recorded was 26° F. below zero.

No marked loss due to winterkilling was noted on any of the varieties under experiment, but on account of the coolness of April practically no growth was made until the last week of the month.

COMPARATIVE CONDITION OF DIFFERENT STRAINS OF CLOVER IN THE SPRING OF 1905.

On May 13 observations were made on the comparative condition of the stand on all the plats. According to these, of the seeds from domestic sources the strains from eastern Ohio, northern Indiana, and the commercial samples made the best showing at this time. The poorest of the domestic strains at this time were those from Tennessee, Missouri, Nebraska, Michigan, and Illinois. The best of the Russian strains were Nos. 15 and 17, from the Kief and Mogileff governments, respectively, while the poorest were Nos. 16 and 18, from Orel and Courland.

The best strain of known origin according to the observations of May 13 was that from eastern Ohio, while the poorest was that from Courland.

YIELDS OF GREEN MATTER.

The following table shows the yield and other data with reference to the series of plats used in determining the amount of green matter produced to the acre:

TABLE IX.—*Yields of clover on Field F used in making green-matter determinations, St. Anthony Park, Minn., 1905.*

No.	Source.	Date of first bloom.	Date of full bloom.	Date cut.	Average height when cut.	Green matter to acre.
					Inches.	*Pounds.*
1	Commercial seed (Western Bulked)	June 12	June 28	June 28	30	21,500
2	Western Ohio	June 13	June 27	do	31	20,900
3	Northern Indiana	June 11	June 26	do	30	22,000
4	Southern Indiana	June 9	do	do	30	20,400
5	Illinois	June 10	do	do	30	21,000
6	Missouri	June 12	do	do	28	19,400
7	Iowa	June 13	do	do	28	21,200
8	Commercial seed (not inoculated)	do	June 28	do	27	20,100
9	Commercial seed (inoculated)	June 12	do	do	28	19,900
10	Michigan	June 11	June 27	do	28	18,900
11	Nebraska	June 10	June 28	do	30	21,300
12	Eastern Ohio	June 11	June 27	do	30	21,700
13	Kentucky	June 12	June 25	do	20	21,400
14	Tennessee	June 11	June 27	do	30	18,000
15	Kief, Russia	June 10	June 25	do	29	21,000
16	Orel, Russia	June 15	(Practically no blossoms.)	do	30	24,100
17	Mogileff, Russia	June	June 30	do	31	24,400
18	Courland, Russia	June 15	June 27	do	28	20,000
19	Wisconsin	June 12	June 28	do	28	21,900
20	Oregon	June 13	June 27	do	27	20,000
21	Pennsylvania	June 12	do	do	26	20,600

COMPARISON OF CLOVER NO. 16 WITH OTHER STRAINS.

An inspection of Table IX shows that clovers Nos. 16 and 17, from Orel and Mogileff, respectively, were the heaviest producers of green matter, the yield of the latter being the greater. In this connection it should be noted that No. 17 was harvested after coming almost into full bloom, while No. 16, according to notes taken on the date of cutting, had practically no blossoms. From this it seems probable that the Orel clover was harvested fully two weeks before it had reached the same state of maturity that had been attained by the other strains. Despite this fact it was outranked in yield only by the strain from Mogileff, which lacked but two days of being in full bloom. There can be no doubt that the Orel strain would have given a yield of several thousand pounds more to the acre had it been allowed to reach the stage of maturity at which it is customary to cut clover for hay.

The Orel clover exhibited the same fineness of texture, absence of hairiness, erect habit of growth, succulence, etc., that were observed on the plats in Nebraska and South Dakota. These qualities are not by any means common to all of the Russian strains with which experiments have been made. Another strain not used in the States under discussion, obtained from Ufa, in the cold, almost snowless steppe region of eastern Russia, resembles No. 16 very strikingly. Nos. 15 and 17 resemble the foregoing in some of their qualities, but like No. 18, which in these respects is practically identical with the American strains, they are readily distinguishable in the field.

The lowest yield was given by the seed from Tennessee. The strains that produced less than 20,000 pounds of green matter are the Tennessee, Michigan, Missouri, and commercial sample No. 9. The largest yield produced by seed from domestic sources was 22,000 pounds in the case of No. 3 from northern Indiana.

YIELDS OF FIELD-CURED HAY.

Table X shows the yield to the acre and other data regarding Field W, which was devoted to determining the comparative production of field-cured hay.

TABLE X.—*Yields of clover on Field W, used in determining the production of field-cured hay, St. Anthony Park, Minn., 1905.*

No.	Source.	Date of first bloom.	Date of full bloom.	Date when cut.	Average height when cut.	Field-cured hay to acre.
					Inches.	*Pounds.*
1	Commercial seed (Western Bulked)	June 13	June 28	June 30	30	4,320
2	Western Ohio	do	June 27	June 29	31	4,248
3	Northern Indiana	June 15	June 28	do	30	4,468
4	Southern Indiana	June 14	June 27	do	30	4,800
5	Illinois	June 11	June 26	June 30	30	4,068
6	Missouri	do	June 25	do	28	4,400
7	Iowa	June 13	June 26	June 29	28	4,120
8	Commercial seed (not inoculated)	June 11	June 28	June 30	27	4,420
9	Commercial seed (inoculated)	June 12	June 29	do	28	4,394
10	Michigan	June 10	June 27	June 29	28	4,109
11	Nebraska	June 15	do	do	30	4,308
12	Eastern Ohio	June 12	June 26	do	30	4,800
13	Kentucky	June 11	June 27	do	30	4,120
14	Tennessee	do	June 25	do	30	3,640
15	Kief, Russia	June 13	June 28	June 30	29	4,020
16	Orel, Russia	June 16	(Few blossoms.)	do	30	5,320
17	Mogileff, Russia	June 15	June 30	do	31	5,000
18	Courland, Russia	June 13	June 27	do	28	3,780
19	Wisconsin	June 12	June 26	June 29	28	3,760
20	Oregon	June 13	do	June 30	27	4,460
21	Pennsylvania	June 10	do	June 29	26	4,480
	Total					91,035

ORDER IN WHICH THE VARIOUS STRAINS MATURED.

A variability similar in some respects to that observed in Nebraska may be noted with reference to the length of time required to mature the different strains. On the University farm they reached the proper stage for harvesting in the groups given below, those maturing earliest being given first:

Group I.—Missouri; Tennessee.

Group II.—Illinois; Iowa; Wisconsin; Oregon; Pennsylvania; eastern Ohio.

Group III.—Kentucky; western Ohio; southern Indiana; Courland; Nebraska; Michigan.

Group IV.—Northern Indiana; commercial samples 1, 8, and 9; Kief.

Group V.—Mogileff.

Group VI.—Orel.

COMPARISON OF YIELDS OF FIELD-CURED HAY.

The lowest yield of the domestic varieties was 3,640 pounds, produced by the Tennessee seed, while the highest was 4,800 pounds, produced by the seed from eastern Ohio and southern Indiana. No. 18, from Courland, gave the lowest yield of the Russian sorts, 3,780 pounds, while No. 16, from Orel, gave the largest return of any variety in the test, 5,320 pounds. No. 16 was harvested on June 30, when it was still very immature, having but few blossoms. Inasmuch as increase in substance is progressing most rapidly in the period leading up to and just preceding full maturity, it is very probable that the Orel clover would have given a considerably higher yield had it been allowed to mature properly. Judging from the performance of this variety at other stations it should have been cut from ten to twelve days later than was the case. This fact should be borne in mind when noting that No. 16 yielded only 520 pounds more than its nearest competitor, 1,176 pounds more than the average for all plats, and 1,600 pounds more than the poorest strains.

THE EXPERIMENT IN NORTH DAKOTA.

LOCATION, SOIL, AND DRAINAGE.

The experiment in North Dakota was conducted on the Experiment Station farm, near Fargo, in cooperation with Prof. J. H. Shepperd, who has been assisted by Mr. O. O. Churchill.

On account of the fact that a larger area was not available, the test was made on half-acre plats. With one or two exceptions the same series of varieties was used as in Nebraska, South Dakota, and Minnesota.

The field used has a wonderfully uniform soil, consisting of jet black clay loam several feet in depth. It is rich in organic matter and in lime, both in the form of carbonate and sulphate. The subsoil is a silty clay of grayish-brown color, which extends to a depth of about 6 feet. The surface soil seems to have a slight admixture of the heavy, black, waxy, clay soil locally called "gumbo." The general soil of the field is quite typical of the best soil in the Red River Valley.

Continuous cropping with wheat has seriously depleted most of the soils of this valley, and they no longer produce the abundant yields that characterized them from ten to twenty years ago. No systematic rotation of crops containing a legume is in general use, and to this may justly be attributed the gradual running down of yields of the cereals which have hitherto been cultivated almost exclusively. The growing of clover is an undeveloped industry in North Dakota. This is due in great part to the fact that wheat farming has hitherto been so profitable, and to the further fact that until recently a general impression has prevailed that clover growing could not be carried on with success. The work of the State Experiment Station during recent years has amply demonstrated that eastern North Dakota, at least, may be considered as peculiarly adapted to clover culture. The writer has never seen anywhere in the clover-growing regions of the United States a finer field of clover than that on which this experiment with regional varieties was conducted. (Pl. III, fig. 1.)

The drainage of the experimental tract is, in common with most of the soils of the Red River Valley, rather poor. This applies to both surface drainage and underdrainage, and is due to the practically "dead level" of the country, which gives the rivers draining the area a very slight fall, and also to the impermeability of the soil to water. In this connection a fact of some interest and possible importance was noted during the summer of 1905, when on account of the wetness of the season it was impossible to harvest a large percentage of the wheat crop of the valley. The clover field, on account of the magnitude of the transpiration of this crop, repeatedly became dry enough to cut after a few days of sunshine, while the neighboring fields of ripened wheat never dried out sufficiently to permit of their being harvested. In regions having heavy soils, where the most rigid conservation of moisture is not necessary, this fact may furnish an added reason for every farmer's sowing clover seed at the rate of from three to six pounds per acre with all of his small grains.

PREPARATION OF LAND, SEEDING, AND SUBSEQUENT TREATMENT.

In regard to the crops previously grown on the field, preparation of the seed bed, nurse crop used, and notes concerning the growth of the strains during the first year, the data below are given from Professor Shepperd's annual report for 1904.[a]

> The land used for this trial produced a crop of corn in 1902, barley in 1903, and clover trial plats were seeded with wheat as a nurse crop in 1904. The field had been fall-plowed in 1903. It was disked on May 10 and harrowed twice with a peg-toothed harrow on May 11. The land was very wet in the spring and after the excess of water finally evaporated a period of very dry weather caused the soil to bake. The seed bed was far from being in an ideal condition on May 12, the date upon which the wheat was seeded. The wheat was sown at the rate of 5 pecks per acre with Fife seed. Four days later the clover seed was sown by hand at a rate slightly less than 10 pounds per acre. The clover seed was covered by harrowing with a peg-toothed harrow.
>
> Notes recorded June 15 state that the wheat was showing a good stand and that the clover plants had appeared above the surface. On the above date it was observed that the clover was showing especially well upon the higher places in the almost level field.
>
> On the dates July 25 and 26, the wheat, which was just forming kernels, was cut for hay and removed from the field. The sickle bar was set as high as the machine would allow and left the stubble about 5 inches high. The best of the clover was so high upon that date that it was clipped off by the sickle.
>
> On August 2 Missouri (No. 6), Eastern Ohio (No. 12), Russian (No. 15), and Wisconsin (No. 19) made a much better showing than the plats from other sources of seed. Observations recorded on September 10 show especially favorable to Missouri (No. 6) and Wisconsin (No. 19), while Illinois (No. 5) and Russian (No. 15) were also reported as showing well.

WEATHER CONDITIONS DURING 1904 AND 1905.

On September 10, 1904, immediately after which date a killing frost occurred, there seemed to be a sufficient growth of clover and of wheat stubble to form a moderate winter protection for the clover plats.

With the exception of August, which had a total precipitation of only 0.69 inch, there was an abundance of moisture throughout the growing season. The mean temperature during June, July, and August was from 2 to 5 degrees below normal.

The winter of 1904–5 was quite severe, but in spite of the long-continued cold and low temperatures no loss due to winterkilling was observed on any of the plats.

According to notes taken on May 1 the strains from Mogileff, Courland, Michigan, Kentucky, and Tennessee, in the order given, showed the poorest stands. The best stand of all was on the Illinois plat, which was closely seconded by those sown to seed from eastern Ohio and Nebraska.

---

[a] Fifteenth Annual Report, North Dakota Agricultural Experiment Station, pp. 96–97.

The following table shows the comparative yield of each variety under experiment, also date of first bloom, full bloom, and cutting, and average height of plants when cut:

TABLE XI.—*Yield, time of first and full bloom, height, and date of cutting of clover at Fargo, N. Dak., 1905.*

No.	Source.	Date of first bloom.	Date of full bloom.	Date when cut.	Average height when cut.	Yield.
					Inches.	*Pounds.*
1	Commercial seed (Western Bulked)	June 20	July 8	July 8	30	5,220
2	Western Ohio	do	July 7	do	27	4,950
3	Northern Indiana	do	do	do	29	4,484
4	Southern Indiana	do	do	do	29	4,860
5	Illinois	do	do	do	28	4,830
6	Missouri	do	do	do	29	5,510
7	Iowa	do	do	do	29	3,960
8	Commercial seed (not inoculated)	do	do	do	30	4,680
9	Commercial seed (inoculated)	do	do	do	30	4,140
10	Michigan	do	do	do	32	3,750
11	Nebraska	do	do	do	28	5,080
12	Eastern Ohio	do	do	do	32	5,370
13	Kentucky	do	do	July 10	27	4,610
14	Tennessee	do	do	do	30	5,090
15	Kief, Russia	do	do	do	28	4,200
16	Orel, Russia	(No blossoms when cut.)		do	34	4,062
17	Mogileff, Russia	(Few blossoms when cut.)		do	28	4,350
18	Courland, Russia	June 20	July 7	do	30	4,470
19	Wisconsin	do	do	do	28	4,380
20	Oregon	do	do	do	28	4,300

COMPARISON OF YIELDS.

The heaviest yields of American strains of clover of known origin were secured from the Missouri and eastern Ohio samples, followed rather closely by those from Tennessee and Nebraska. The lightest yields of the American strains were obtained from seed from Michigan, Wisconsin, and Oregon.

The Russian strains were among those giving the lowest yields, the Orel clover yielding next to Michigan seed, the lightest crop. Clover No. 18, the earliest in maturing, produced the largest crop of the Russian sorts.

The low yield of clover No. 16 is adequately accounted for by the fact that in order to insure the securing of seed of this variety the plat was cut two weeks before it had properly matured. Plate III, figure 1, shows the Orel clover, immature and without blossoms, in the foreground, the more mature Russian form from Kief in the near background, and the fully matured Tennessee plat in the farther background.

Here, again, the hairless form exhibited all of the desirable forage qualities noted at the other stations, and but for being harvested so exceedingly early would no doubt have shown the same yielding qualities as elsewhere.

The following table summarizes the yields of each of the varieties grown in the experiments described above:

TABLE XII.—*Comparison of yields of field-cured clover hay at all northwestern stations, 1905.*

No.	Source.	Nebraska.	South Dakota.	Minnesota.	North Dakota.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	Commercial seed (Western Bulked)	5,700	4,400	4,320	5,220
2	Western Ohio	4,980	3,500	4,248	4,950
3	Northern Indiana	4,780	2,510	4,468	4,484
4	Southern Indiana	5,020	2,710	4,800	4,860
5	Illinois	4,990	3,990	4,068	4,830
6	Missouri	5,010	4,450	4,400	5,510
7	Iowa	3,750	4,130	4,120	3,960
8	Commercial seed (not inoculated)	5,950	3,998	4,420	4,680
9	Commercial seed (inoculated)	6,040	4,312	4,394	4,140
10	Michigan	5,570	4,400	4,109	3,750
11	Nebraska	3,590	4,500	4,308	5,080
12	Eastern Ohio	5,080	4,640	4,800	5,370
13	Kentucky	5,540	3,420	4,120	4,610
14	Tennessee	4,670	3,970	3,640	5,090
15	Kief, Russia	5,840	4,080	4,020	4,200
16	Orel, Russia	7,100	5,610	5,320	4,062
17	Mogileff, Russia	5,750	4,030	5,000	4,350
18	Courland, Russia	4,570	3,280	3,780	4,470
19	Wisconsin	4,950	2,970	3,760	4,380
20	Oregon	4,930	4,560	4,460	4,300
21	Pennsylvania	4,460	1,800	4,480	....
22	New York	....	2,400	....	....

OTHER EXPERIMENTS IN WHICH CLOVER NO. 16 WAS INCLUDED.

In addition to the Northwestern States already mentioned, to whose conditions the hairless clover seems best adapted and where its performance has been described in some detail, this form was also grown in the following sections:

(1) In Ohio, in cooperation with the Agricultural Experiment Station, on the farm of Mr. E. D. McIntyre, near Wooster. The work here was under the direction of Prof. C. E. Thorne, director of the station.

(2) In Canada, on the farm of the Ontario Agricultural College and Experiment Station. The work here was done under the immediate direction of Prof. C. A. Zavitz, experimentalist.

(3) In Indiana, in cooperation with Mr. Theo. H. Reed, on the farm of Mr. L. B. Harris, near Rushville, Rush County. This county is in the heart of the heaviest clover-seed-producing section in the United States and, according to the census of 1900, produced more clover seed than any county in the country.

At Wooster the Orel clover gave one of the highest yields, while at Rushville it produced one of the poorest crops of all the varieties tested, which was probably due to the fact that it was harvested before maturing. Although its forage qualities and botanical characters were identical with those exhibited at other stations, this variety does not seem to be particularly adapted to the conditions existing in Ohio and Indiana.

In Ontario, however, the Orel clover and a somewhat similar form from Ufa gave the heaviest yields. The data for this station are so complete that they are given in full in the following table. A number of varieties were here included that were not used in experiments in the States previously described. The data for these are also included. The experiment was made on small plats, from which the acre yields have been computed. (See Pl. III, fig. 2.)

TABLE XIII.—*Yield and other data for clover grown at Guelph, Ontario, in 1905.*

No.	Source of seed.	Date of first bloom.	Date of full bloom.	Date when cut.	Average height when cut.	Yield of green matter to acre.	Yield of cured hay to acre.
					Inches.	*Pounds.*	*Pounds.*
1	Commercial seed (Western Bulked).	June 15	July 2	July 13	30	18,640	3,633
2	Western Ohio	June 16	June 28	July 3	30	18,120	2,760
3	Northern Indiana	June 15	June 27	June 30	26	19,080	2,960
4	Southern Indiana	June 13	do	June 29	26	18,400	2,440
5	Illinois	do	do	June 30	27	18,240	2,720
6	Missouri	do	do	July 3	27	16,280	2,640
7	Iowa	June 15	do	do	27	16,880	2,320
8	Commercial seed (not inoculated).	do	June 30	July 7	29½	18,080	3,520
9	Commercial seed (inoculated)	do	June 29	do	28½	18,360	3,520
10	Michigan	June 13	June 26	June 29	27½	18,200	2,240
11	Nebraska	do	June 27	June 30	27½	18,920	2,720
12	Eastern Ohio	do	do	do	26	17,160	2,320
13	Kentucky	June 14	June 28	July 5	27½	17,120	2,840
14	Tennessee	do	June 29	do	29½	17,680	2,800
15	Kief, Russia	June 17	June 30	July 11	27½	15,560	2,800
16	Orel, Russia	June 18	July 14	July 16	26½	20,800	4,360
17	Mogileff, Russia	June 17	July 2	July 13	30	19,320	4,080
18	Courland, Russia	June 14	June 29	July 5	29	23,280	2,880
19	Wisconsin	June 13	June 27	July 6	28½	17,240	2,960
20	Oregon	do	June 28	do	29½	16,880	2,680
21	Pennsylvania	do	June 26	July 2	27½	19,000	2,960
22	New York	June 16	June 29	July 7	29½	19,280	3,640
24	Vitebsk, Russia	June 14	do	July 6	30½	19,360	3,200
25	Perm, Russia	June 16	do	July 12	31	18,840	3,680
28	Ufa, Russia	June 18	July 8	July 17	26	21,040	4,520
29	Kief, Russia	June 16	July 2	July 11	29½	20,240	3,440

Here, again, as was the case in the Northwest, the hairless Orel clover was the latest variety in maturing, and in yield it was surpassed only by the strain from Ufa. The Michigan seed gave the lowest yield of all, 2,240 pounds, while the New York seed gave the highest of the American strains of known origin, 3,640 pounds.

Clover No. 16 yielded 2,120 pounds more than the poorest and 720 pounds more than the best domestic strain, and it produced 1,600 pounds more than the average of all plats.

The same characters and qualities previously noted in this variety were found constant in this experiment.

The record of mean temperatures and precipitation at Guelph for the months of the growing season of 1905 up to and including the time of harvesting the hay crop, in comparison with the normals for the same months at Orel, follows:

TABLE XIV.—*Temperature and rainfall for certain months during 1905 at Guelph, Ontario, compared with the normals for the same months at Orel, Russia.*

Month.	Temperature.		Precipitation.	
	Guelph.	Orel.[a]	Guelph.	Orel.[b]
	Mean.	Normal.	Total.	Normal.
	°*F.*	°*F.*	*Inches.*	*Inches.*
April	41.15	38.08	1.75	1.57
May	52.84	56.10	3.89	1.87
June	62.58	63.55	3.54	1.97
July	67.67	67.76	4.66	2.80

[a] Wild, Die Temperaturverhältnisse des Russischen Reiches, St. Petersburg, 1881.
[b] Wild, Die Regenverhältnisse des Russischen Reiches, St. Petersburg, 1887.

DESCRIPTION OF NEW TYPE AND NAME PROPOSED.

Although American red clovers from widely separated sources vary greatly among themselves, these variations do not appear to be constant and are not of sufficient importance in any case to justify the giving of varietal rank in the botanical sense to any of the regional strains of domestic origin used in these experiments. On the other hand, the distinctions between the hairless Orel clover and the American clovers are so numerous and well defined in the plant itself, though not apparent in the seed, that it seems advisable, on account of the probable economic importance of the former, to give it a distinct varietal name. Almost complete lack of hairiness is perhaps the most striking distinguishing mark of this form in the field, but the variability in amount of hairiness, differing as it does even in American strains from more or less widely separated sources, makes this an undesirable quality on which to base a name. On account of the value both from an economic standpoint and as a botanical character of the general leafiness of the plant and the persistence and number of basal leaves produced, the writer proposes for this variety the designation *Trifolium pratense* var. *foliosum*, based on these characters. A type specimen has been deposited in the National Herbarium.

In addition to lack of hairiness and the unusual leafing qualities referred to above, the plants of this variety have a more upright habit of growth and branch more freely than the American form. Besides the foregoing, there are other differences of a more purely botanical character. The white spots on the leaflets which are so prominent in the ordinary form are frequently absent from plants of this variety and often when present can scarcely be seen. The largest mature leaves of the smooth clover are about the same size as the smallest of the American strains. The flower heads are also smaller, less compact, and rather more elongate than those of the latter. The bracts subtending the inflorescences are smaller in this form; also more circular in outline, less prominently nerved, of finer texture, and glabrous throughout except at the apex, which is sometimes tipped with a few slender hairs. In the American form the under side and margin of these bracts are covered with many fine hairs.

The stipules also show some constant dissimilarities. On plants of equal age the stipules of the American strains are larger, hairy on the back, margins, and tip, and in the cured hay are harsh and woody; in the Orel clover they are smaller, of finer texture, much less prominently veined, and hairless except at the tip, where there is usually a tuft of hairs. According to a comparison of a large number of measurements of the stipules and petioles of the basal leaves of both forms, although the stipules of No. 16 are shorter, the petioles are longer. In the former the stipules constitute about 8 per cent of the total length; in the latter, about 15 per cent. The average length of the stipules in both No. 16 and the American forms was found to be 22 mm. and 24 mm., respectively, and of the petioles 270 mm. and 160 mm., respectively. The same proportion was not found to hold true in regard to the leaves of flower-bearing stems. In these, both the stipules and petioles, comparing similar parts of plants of about equal development, are shorter in the hairless form. The average lengths of stipules and petioles in the latter are 20 mm. and 104 mm., while in the domestic form they are 22 mm. and 114 mm., respectively. (See Pl. II, fig. 1.)

The calyx of the smooth clover is sparingly covered with short, appressed hairs, while in the hairy American form it is densely covered with more erect hairs, which are in general from 1½ to 2½ times longer. The calyx in both forms is five-toothed, one tooth being considerably longer than the other four. In the American form the long tooth appears to be always more than twice as long as the four short ones, which are of about equal length, while in the variety *foliosum* the long tooth seems never to be as much as twice as long as the others.

The few hairs that occur on the Orel clover, no matter upon what portion of the plant they are found, are comparatively very short and always appressed to the part bearing them, while in the domestic clover they are numerous, in young plants matted (see Pl. II, fig. 2), and extend at right angles from the organ on which they are borne.

LATER OBSERVATIONS.

Notes taken during May and June of 1906 on the plats in Nebraska and North Dakota, now in their third year, tend to confirm the observations recorded for all stations during the growing season of 1905. In only one case was the seed production of clover No. 16 satisfactory under the method of taking two full crops. This was in southern Indiana, where its yield was fully up to the average for other varieties.

At Carlton, Oreg., on Mr. F. J. Canfield's farm, another late Russian strain, resembling No. 16 in many respects, gave a very satisfactory yield of seed. In this case only one crop, the seed crop, was harvested, the field having previously been pastured quite closely with hogs and sheep until early summer. Although cut at the same time as the earlier strains, the late Russian form indicated such promising yielding qualities as to insure a large crop of seed with proper handling. The need for having all strains ready to hull at the same time made necessary the too early cutting of this strain, which was obtained from Ufa and has been previously referred to in connection with the experiment in Ontario.

From the observations made on the seed production of clover No. 16, it is evident that the chief obstacle to the successful introduction of the new variety into commercial culture rests on the fact that seed true to type will be difficult to secure, and when it has been secured it will require some time before a sufficient quantity will have been propagated to sow any considerable area. For this reason it is suggested that growers securing seed of this variety from any source whatever should devote the greater part of their field to seed production. On account of its lateness it may not be possible, except in southern parts of the clover region, where the seasons are long, to secure both a hay and a seed crop in any one year. Therefore growers in the North and Northwest are advised not to attempt to secure two full crops, but rather to mow a light crop of hay late in May—say, between May 20 and June 1—and then allow the field to go to seed. In sections where the practice of pasturing is permissible it may prove more profitable to pasture the fields until about May 25 instead of taking off an early cutting. The date of this cutting or of the pasturing will of course vary in different sections.

On account of the persistence of the leaves and the general character of plant, the straw that remains after hulling clover No. 16 should furnish considerably more feed than that of the hairy type of clover.

The fact that the seedlings of the new clover are almost absolutely free from hairiness may prove a help in determining the genuineness of any sample. Where seed is purchased long enough in advance of seeding to make it possible, the germination test could be prolonged in pots for thirty days with a view to examining the seedlings. By this time the ordinary clovers are very hairy, while No. 16 remains almost perfectly smooth.

The Department of Agriculture is making an effort to secure a new importation from the same source as the original seed used in these experiments. This seed when obtained will be planted for the most part in large fields in order to secure a supply for use in distribution and for experimental work.

A very interesting fact in connection with the 3-year-old plats of the Orel clover, indicating either unusual cold-resisting qualities or a tendency to become perennial, was noted both at Fargo, N. Dak., and at Oakland, Nebr. In both of these cases the new type has the best stand remaining of all the 20 or 21 strains used in the experiment; in fact, at Oakland, No. 16 is the only plat on the field that has a full stand.

In a report dated June 25, 1906, just received from Mr. John P. Young, he states that with the exception of Russian clover No. 16 all of the plats have but a light sprinkling of plants from the old seed, and he is of the opinion that the majority of these were produced from seed matured in the autumn of the seeding year 1904. On a large portion of the field not more than one or two plants appear on 10 square feet of ground. Returning again to the Orel clover, Mr. Young refers to its upright habit, abundant foliage, soft velvety texture, and the preference that cattle show for it, and states that "it is the only strain on the whole field that has a full stand from the first seeding."

This tendency to become perennial, the absence of hairiness, and the other desirable qualities mentioned by Mr. Young continue to distinguish the new form from the ordinary type of red clover now in use.

SUMMARY.

Red clover, on account of its great value as a forage plant and because of its power of renewing and maintaining the fertility of the soil, is one of the most important crop plants of modern agriculture.

In the course of an extensive experiment with seed from different sources there appeared a variety, hitherto not used in the United States, possessing certain advantageous qualities which make it desirable to introduce it into American farming.

The seed of this variety was secured from the "Black Earth" region in the eastern part of the Orel government of Russia. The soil and climate of this section resemble strikingly those of our own northwestern prairie country, particularly Nebraska, Minnesota, and the Dakotas.

This variety is distinguished by the dustlessness of its hay, due to almost complete absence of hairiness from all parts of the plant, by its heavy yields for the first crop, by its leafiness and the persistence of the basal leaves, by the succulence of the stems, which improves greatly the quality of the hay and reduces the waste due to woody, uneatable portions, by greater palatability than hay from domestic seed, and by the fact that it comes to proper maturity for harvesting from ten days to two weeks later than the ordinary American red clover.

Except in certain sections and for certain purposes this variety is not recommended for supplanting domestic red clover, but rather for supplementing the latter.

Although the hairless Orel clover can be readily distinguished from the American form on the field, there is no apparent difference in the seed. The Department of Agriculture has at the present time no seed for general distribution, the supply on hand being sufficient only for purposes of experimental propagation.

Before purchasing seed from foreign sources, purporting to be of this variety, farmers are urged to take special precautions against the introduction of dangerous weed pests and to assure themselves as far as possible as to the genuineness of the seed.

PLATES.

DESCRIPTION OF PLATES.

Plate I. *Frontispiece.* Fig. 1.—Plant of hairless Orel clover, almost mature. Fig. 2.—Mature plant of American red clover.

A portion of the plant from which figure 1 was made has been deposited in the United States National Herbarium (No. 409983) as a type specimen of *Trifolium pratense* var. *foliosum.* Formalin material from the same plant is preserved in the Laboratory of Plant Life History.

Plate II. Fig. 1.—Stems, stipules, and bases of petioles of American and of hairless Orel clover (1½ times natural size). Fig. 2.—Young plants of hairless Orel clover and American red clover, showing smooth and hairy types (five-eighths natural size).

The photographs from which Plates I and II were made are of seventeen-months-old plants of the second crop, grown on the farm of the Minnesota Experiment Station, at St. Anthony Park.

Plate III. Fig. 1.—Large plats used in clover experiments, North Dakota Agricultural College, Agricultural College, N. Dak. (Negative by O. O. Churchill.) Fig. 2.—Small plats used in experimental work, Ontario Agricultural College and Experiment Station, Guelph, Ontario. (Photograph furnished by Prof. C. A. Zavitz.)

O

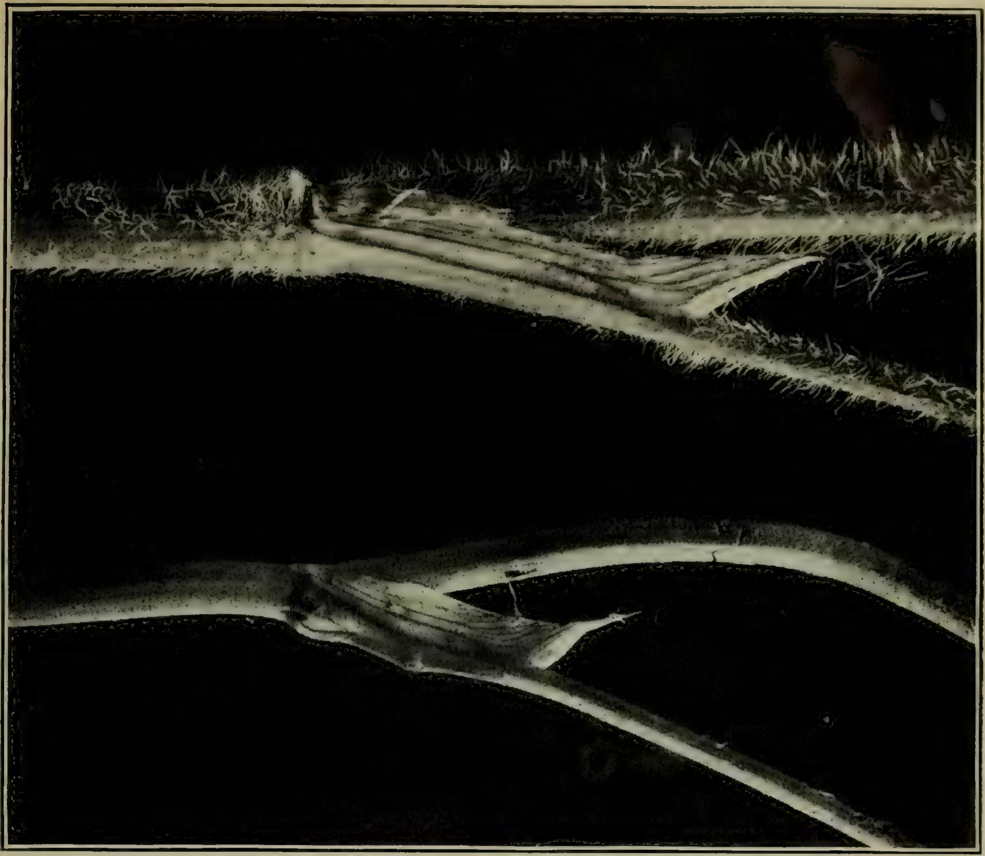


FIG. 1.—STEMS, STIPULES, AND BASES OF PETIOLES OF AMERICAN AND OF HAIRLESS OREL CLOVER. (ONE AND ONE-HALF TIMES NATURAL SIZE.)

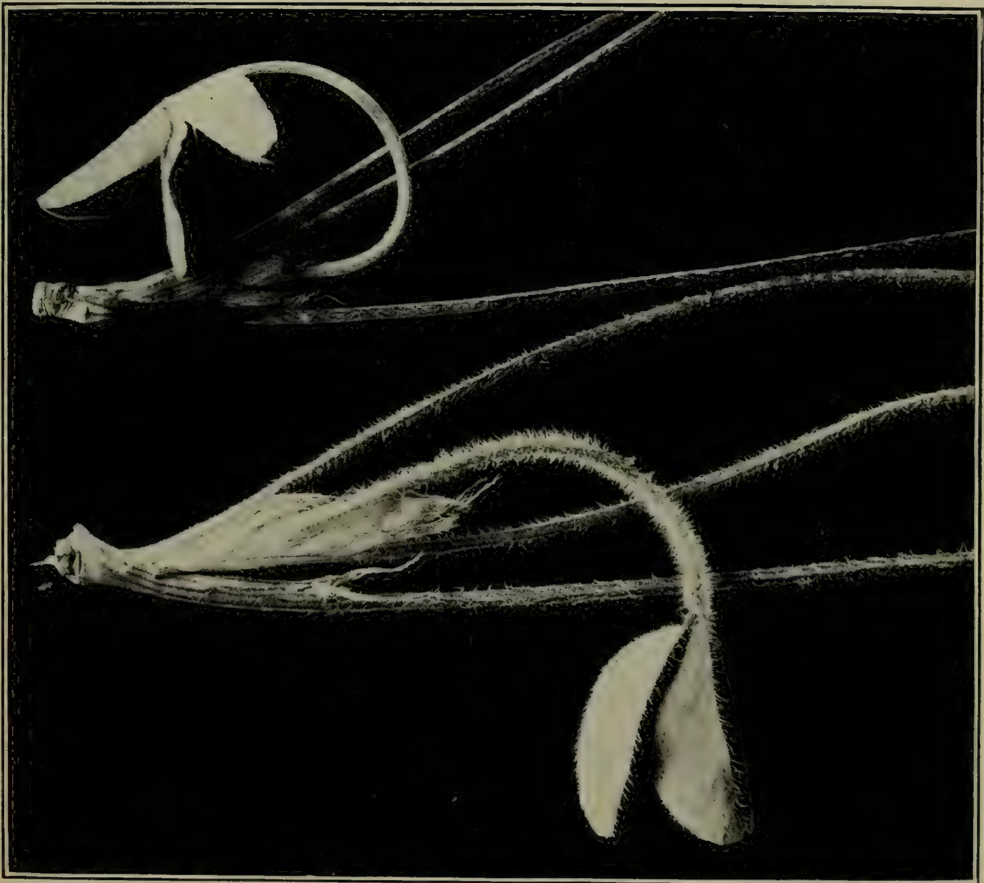


FIG. 2.—YOUNG PLANTS OF HAIRLESS OREL CLOVER AND AMERICAN RED CLOVER, SHOWING SMOOTH AND HAIRY TYPES. (FIVE-EIGHTHS NATURAL SIZE.)

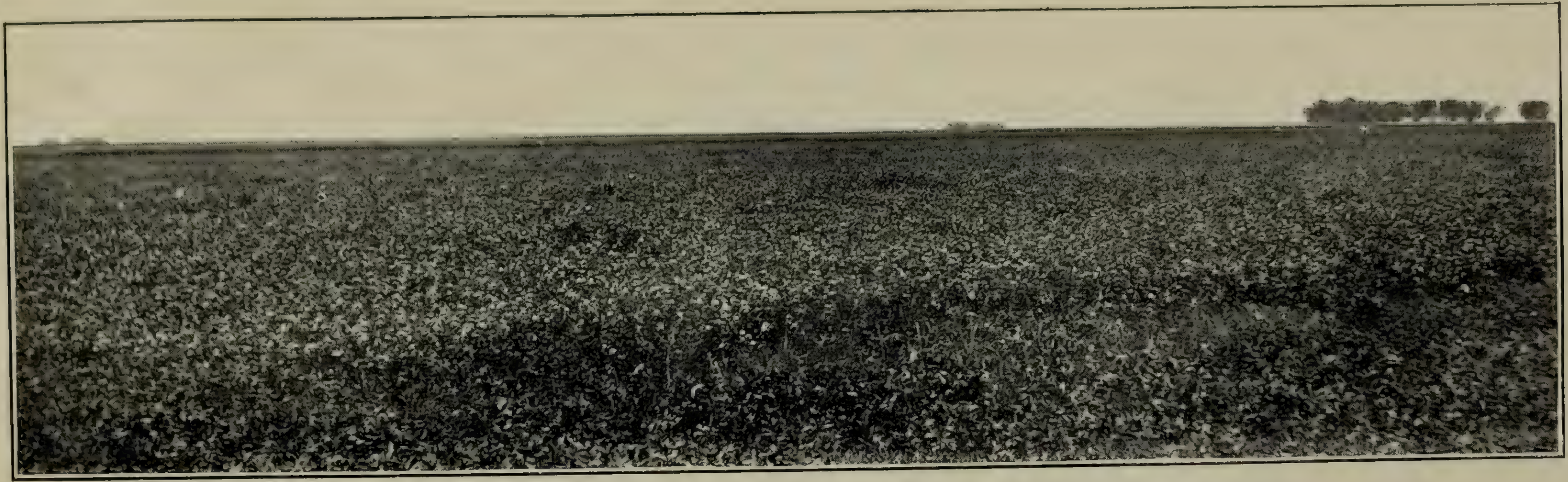


FIG. 1.—LARGE PLATS USED IN CLOVER EXPERIMENTS, NORTH DAKOTA AGRICULTURAL COLLEGE.

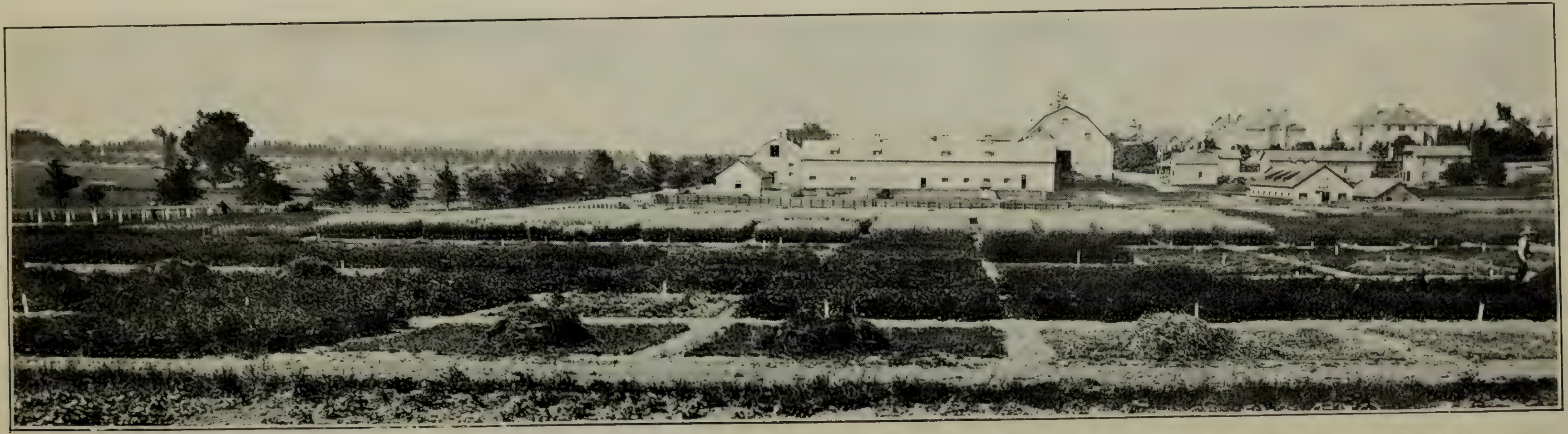


FIG. 2.—SMALL PLATS USED IN EXPERIMENTAL WORK, ONTARIO AGRICULTURAL COLLEGE AND EXPERIMENT STATION, GUELPH CANADA.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 96.

B. T. GALLOWAY, *Chief of Bureau.*

TOBACCO BREEDING.

BY

A. D. SHAMEL

AND

W. W. COBEY,

IN CHARGE OF TOBACCO BREEDING EXPERIMENTS,
PLANT BREEDING INVESTIGATIONS.

ISSUED MARCH 12, 1907.

239410
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1907.

BUREAU OF PLANT INDUSTRY.

Pathologist and Physiologist, and Chief of Bureau, Beverly T. Galloway.
Pathologist and Physiologist, and Assistant Chief of Bureau, Albert F. Woods.
Laboratory of Plant Pathology, Erwin F. Smith, Pathologist in Charge.
Investigations of Diseases of Fruits, Merton B. Waite, Pathologist in Charge.
Plant Breeding Investigations, Herbert J. Webber, Physiologist in Charge.
Plant Life History Investigations, Walter T. Swingle, Physiologist in Charge.
Soil Bacteriology and Water Purification Investigations, Karl F. Kellerman, Physiologist in Charge.
Bionomic Investigations of Tropical and Subtropical Plants, Orator F. Cook, Bionomist in Charge.
Drug and Poisonous Plant Investigations and Tea Culture Investigations, Rodney H. True, Physiologist in Charge.
Physical Laboratory, Lyman J. Briggs, Physicist in Charge.
Taxonomic Investigations, Frederick V. Coville, Botanist in Charge.
Farm Management Investigations, William J. Spillman, Agriculturist in Charge.
Grain Investigations, Mark A. Carleton, Cerealist in Charge.
Arlington Experimental Farm, Lee C. Corbett, Horticulturist in Charge.
Sugar Beet Investigations, Charles O. Townsend, Pathologist in Charge.
Western Agricultural Extension, Carl S. Scofield, Agriculturist in Charge.
Dry Land Agriculture, E. Channing Chilcott, Expert in Charge.
Pomological Collections, Gustavus B. Brackett, Pomologist in Charge.
Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge.
Experimental Gardens and Grounds, Edward M. Byrnes, Superintendent.
Seed and Plant Introduction Investigations, David Fairchild, in Charge.
Forage Crop Investigations, Charles V. Piper, Agrostologist in Charge.
Seed Laboratory, Edgar Brown, Botanist in Charge.
Grain Standardization, John D. Shanahan, Expert in Charge.
Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge.
Subtropical Laboratory and Garden, Miami, Fla., Ernst A. Bessey, Pathologist in Charge.
Plant Introduction Garden, Chico, Cal., Palemon H. Dorsett, Pathologist in Charge.
Cotton Culture Farms, Seaman A. Knapp, Lake Charles, La., Special Agent in Charge.

Editor, J. E. Rockwell.
Chief Clerk, James E. Jones.

Plant Breeding Investigations.

SCIENTIFIC STAFF.

Herbert J. Webber, *Physiologist in Charge.*

Alkali and Arid Plant Breeding: T. H. Kearney, Physiologist in Charge; L. L. Harter, Scientific Assistant.
Corn Breeding: C. P. Hartley, Assistant Physiologist in Charge; E. B. Brown, Scientific Assistant.
Cotton Breeding: D. A. Saunders and D. N. Shoemaker, Special Agents in Charge of Cotton Laboratories, Waco, Tex.; R. L. Bennett, in Charge of Cooperative Work, Texas Agricultural Experiment Station; S. M. Bain, in Charge of Cooperative Work, Tennessee Agricultural Experiment Station; E. B. Boykin, Special Field Agent; H. A. Allard, Scientific Assistant.
Oat and Potato Breeding: J. B. Norton, Assistant Physiologist in Charge.
Tobacco Breeding: A. D. Shamel, Physiologist in Charge; W. W. Cobey, Special Field Agent; W. W. Garner, Scientific Assistant; W. H. Scherffius, Tobacco Expert.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., September 25, 1906.

Sir: I have the honor to transmit herewith a paper on "Tobacco Breeding," by Messrs. A. D. Shamel and W. W. Cobey, of the Plant Breeding Investigations of this Bureau, and would recommend its publication as Bulletin No. 96 of the Bureau series.

The tobacco-breeding work of the Bureau of Plant Industry has now been under way for several years, and results have been obtained which have attracted widespread attention and proved of very great value to practical tobacco growers. This bulletin is intended to summarize the results secured up to date and to place the knowledge obtained before growers in such a form that they will be able to understand it and apply it in the practical work of improving their crops. The experiments have shown that tobacco can be improved in many important ways, and the methods by which such improvements can be produced are here described in detail. The illustrations form a very important part of the publication and are necessary to enable the grower to understand clearly the character and improvements discussed in the text of the bulletin.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

Page.
Introduction 7
The great variability of tobacco plants 9
The introduction and acclimatization of varieties 12
The structure and arrangement of flowers 17
The necessity for inbreeding 22
The improvement of the shape of leaves 26
The modification of the size of leaves 29
The control of the number of leaves on individual plants 33
The production of nonsuckering types 35
The production of early varieties 37
The improvement of the burning quality 39
The selection of seed plants 44
  Records of breeding work made in the field 47
  Permanent records of breeding work 52
Methods of saving seed 54
Seed separation 57
Disease resistance 60

A new variety produced by seed selection:

  Uncle Sam Sumatra 62

New varieties produced by hybridization and seed selection:

  The Cooley hybrid 64
  The Brewer hybrid 66
Description of plates 70

ILLUSTRATIONS.

PLATES.

PLATE I. Fig. 1.—Connecticut Cuban tobacco plants raised in 1903 from unselected freshly imported seed, showing generally undesirable types. Fig. 2.—Crop of Connecticut Cuban tobacco plants raised in 1905 from seed saved from best plants selected from the field shown in figure 1, showing uniformly a desirable type 72
II. Fig. 1.—Type of Connecticut Cuban tobacco plants saved for seed production. Fig. 2.—The progeny of a single parent plant of Connecticut Cuban tobacco raised from seed saved under bag 72
III. Two types of Connecticut Cuban tobacco which have been inbred for three years, showing the value of the practise of inbreeding in tobacco 72
IV. Two rows of Connecticut Sumatra tobacco showing variation in type. Row on right, Greenleaf type; row on left, Sumatra type 72

Page.

Plate V. Two tobacco plants of same age showing variability in the production of suckers ... 72

VI. Fig. 1.—Four tobacco plants of the same age showing variation in time of maturity. Fig. 2.—Two rows of Connecticut Broadleaf tobacco showing the possibility of the production of early strains. Row on right raised from the seed of an early plant, and row on left from seed of a plant maturing at the usual time ... 72

VII. Two rows of Connecticut Sumatra tobacco grown under uniform conditions. Row on right, poor burning type; row on left, perfect burning type ... 72

VIII. Two rows of Connecticut Sumatra tobacco showing variability in type. Row on right, Belgian type; row on left, Crumple type... 72

IX. Fig. 1.—Two rows of tobacco plants showing the results of the use of heavy and light tobacco seed. Row on left, raised from heavy seed; row on right, from light seed. Fig. 2.—A row of Connecticut Sumatra plants affected with wilt in comparison with a row of plants of the same variety grown from resistant seed ... 72

X. Two rows of Cooley Hybrid tobacco grown under shade ... 72

TEXT FIGURES.

Fig. 1. Belgian type of Connecticut Sumatra tobacco plant ... 15

2. Typical leaf of Belgian type of tobacco ... 16

3. Diagrammatic sketch of tobacco flower ... 18

4. Three tobacco flowers at proper stage for emasculation, and the scissors and forceps used in emasculating flowers ... 20

5. Diagrams showing the superiority of broad over narrow leaves for cigar-wrapper purposes ... 27

6. Tobacco seed plant at proper stage of maturity for the application of a paper bag ... 55

7. Tobacco seed plant showing arrangement of a paper bag for the protection of the flowers from cross-fertilization ... 56

8. Tobacco seed separator ... 58

9. Typical plant of Uncle Sam Sumatra tobacco ... 62

10. Typical leaf of Uncle Sam Sumatra tobacco ... 63

11. Typical plant of the Cooley Hybrid tobacco ... 64

12. Typical leaf of the Cooley Hybrid tobacco ... 65

13. Typical plant of the Brewer Hybrid tobacco ... 66

14. Typical leaf of the Brewer Hybrid tobacco ... 67

B. P. I.—234.

TOBACCO BREEDING.

INTRODUCTION.

The growing importance of the tobacco industry may be realized from a brief summary of the estimates of the value of the crop in the United States in the season of 1906. About 796,099 acres of tobacco were grown, producing an average yield of 857.2 pounds to the acre, or a total of 682,428,530 pounds. The average value of the crop was 10.0 cents a pound, or a total of about $68,232,647. While it is almost impossible to comprehend the magnitude of the value of the manufactured products of tobacco, a glance at the total figures may convey some idea of the development of this great and distinctively American industry. In 1900 the total value of the manufactured products of tobacco was $283,076,546. These products may be divided into three general classes, of which the values were as follows: Cigars and cigarettes, $160,223,152; chewing, smoking, and snuff products $103,754,362; stemmed and rehandled tobacco, $19,099,032. In the manufacture of these products 142,277 people were employed, who earned a total wage of $49,852,484. In addition to the tobacco grown in the United States there was imported into the United States in the year ended June 30, 1906, $4,143,192 worth of tobacco in a manufactured condition and $22,447,514 worth of unmanufactured products, making the total value of the importations during this period $26,590,706. During the same time the exports of manufactured tobacco were valued at $5,410,480, and of unmanufactured tobacco at $28,808,367. In 1891 the tobacco industry furnished almost $50,000,000 revenue to the Federal Government, and the revenue from this source now amounts to about one-eighth of the Government's total net receipts.

The United States now grows by far the largest quantity of tobacco produced by any country in the world. While tobacco was grown by the first settlers in the colonies and was one of their principal cash crops, the extensive development of this industry has been a matter of comparatively recent years. The introduction of tobacco into the different sections of the United States, with their widely varying conditions of soil and climate, has resulted in the production of types adapted to the soils and conditions of these sections, as well as supplying a product for the varied manufactures now demanded by the consumers of tobacco. Improvements in methods of culture, curing, and fermentation have resulted in the production of tobacco having an increased value, but the most important factor in the development of more valuable tobaccos has been the production of improved varieties by seed selection and breeding. The production of these improved varieties adapted to local soil and climatic conditions has made possible the rapid development of the industry and enabled the United States in a comparatively short time to rank as the foremost tobacco-producing country in the world.

The prosperity of the tobacco industry as a whole and of the growers in particular depends on the development of improved varieties of tobacco adapted to the demands of manufacturers and consumers. There is no crop which responds so readily to breeding as tobacco, as has been proved by the experiments of the writers, and it is further true that without careful selection and breeding there is no crop which so quickly deteriorates in yield and quality. The extent of the areas in the United States in which the conditions of soil and climate are suitable to tobacco culture is almost unlimited, so that it seems possible that by giving attention to the production of varieties adapted to those conditions this country can continue to produce an increasingly large yield of valuable tobaccos.

The experiments of the writers have shown that it is possible to increase the yield and improve the quality of the crop by seed selection and breeding. The methods of breeding worked out in the course of these experiments are simple and practical and can be carried out by every grower with little or no extra cost in the production of the crop. The fact that tobacco is perfectly self-fertile and that self-fertilized seed produces more uniform and better developed plants than seed resulting from cross-fertilization within the variety makes it possible by the adoption of proper methods of saving seed to make rapid progress in the improvement of the crop. Improvement in the shape, size, and quality of leaves or increase in the number of leaves borne by the individual plants, all of which can be attained by breeding, means increased profits to the growers and manufacturers, and therefore is of vital interest to all who are interested in the production, manufacture, and consumption of this crop.

The production of new varieties of tobacco by hybridization and selection is a most important phase of tobacco breeding. The new hybrids of native New England varieties with standard foreign-grown varieties, combining certain valuable characters of both parents, described in this bulletin, are good illustrations of the use of breeding in the improvement of the tobacco crop. The making and testing of hybrids are matters of experiment and require considerable time and expense, but experience has shown that the results justify the necessary expenditure.

The production of improved breeds of live stock and varieties of fruits and cereals, in fact, of all crops, might be cited to prove the importance of applying the principles of breeding to the tobacco crop. It is only recently that systematic breeding experiments have been undertaken. It is hoped that the results of the experiments cited in this bulletin will serve as a means of creating general interest in this subject and of inducing investigators, breeders, and growers to turn their attention to the further improvement of their crops.

Tobacco growers in the sections where these experiments have been carried on have generally adopted the improved methods of bagging carefully selected seed plants and of separating the seed, and they are using the improved varieties of tobacco produced in the course of these investigations. In most of these districts certain men have become interested in the careful and systematic breeding of tobacco.

THE GREAT VARIABILITY OF TOBACCO PLANTS.

Under the intensive system of cultivation necessary for the production of profitable crops of tobacco, the condition of the soil, the fertilization, and the cultivation are fairly uniform so far as individual fields are concerned. In those tobacco-growing sections where the best grades are produced it is a common practise to grow tobacco year after year on the same field without rotation, instances being known where more than fifty consecutive crops have been produced on the same field. This system of cropping enables the growers to become thoroly familiar with the character of the soil in all sections of the fields, so that any inequality in fertility can be remedied by the judicious application of manures or commercial fertilizers, or by methods of cultivation. Notwithstanding these favorable circumstances for the production of uniform plants, a careful study of the plants in these fields reveals a great lack of uniformity as regards all characters. This lack of uniformity is particularly noticeable with respect to the variation in number, size, venation, shape, and habit of growth of the leaves borne by individual plants, the time of ripening of the leaves on the same plant and on different plants, the number and size of the suckers, and the structure and arrangement of the flowers and flower heads. From the practical standpoint, there is no more important problem in tobacco culture than the production of uniform crops. A lack of uniformity in the crop not only results in a low yield, as a whole, and more especially of the best and most profitable grades of the cured and fermented product, but also increases the cost of sorting out the different types of leaves into their respective grades for market, the expense of which must be borne directly or indirectly by the grower.

The principal cause of the lack of uniformity in tobacco is cross-fertilization. In tobacco, as in all other crops, seed resulting from cross-fertilization produces many plants unlike either parent. Therefore such seed is undesirable for the general planting of a crop where uniformity is so important a factor. Where the tobacco seed plants are grown without protection from cross-fertilization some of the flowers are cross-fertilized by insects or other agencies. Desirable plants may thus be crossed with undesirable plants in the same field or in adjoining fields, and the plants grown from the seed thus produced are usually extremely variable, some of them resembling the desirable plants from which the seed was harvested, others resembling the inferior plants from which the pollen was carried for crossing, while the remainder are of an intermediate type, unsuited to the purpose for which the crop is grown, and therefore causing a loss to the grower. The writers have observed numberless cases in different tobacco-growing sections where several distinct and worthless new types appeared in the fields, the plants of which were grown from carefully selected seed. These undesirable types could only be accounted for by the accidental crossing of the seed plants the year preceding or at some previous time. The crossing of individual plants of the same strain, even if both are desirable plants, results in undesirable variations, many of which are apparently reversions to earlier and unimproved types of tobacco.

In those varieties of tobacco in which the buds are removed long before the flowers open on all of the plants except those saved for seed production, or where early topping is practised, the opportunity for the crossing of the flowers borne by the seed plants with other plants in the same field is almost wholly limited to the seed plants. However, it frequently occurs that late or diseased plants, or possibly sucker branches that have been overlookt, develop flowers which open at just the right time to allow insects to carry the pollen from these flowers to the seed plants and thus effect cross-fertilization. There is little doubt that many of the plants of irregular and unusual types are produced as a result of this kind of cross-fertilization.

An important cause of variation in tobacco plants is the use of immature seed. Many growers cut off or harvest the seed heads before all of the seed pods have turned brown; hence, before maturity. The writers have observed hundreds of instances where the seed plants have been cut off while many of the flowers were still in bloom. On such seed heads seed pods in all stages of maturity can be found. Some of the pods are fully ripe and contain mature seed, while others have not fully developed. Much of the seed is immature and contains little food for the nourishment of the plantlet. These seed heads are frequently thrashed out with a flail or the pods are crushed by the hands in order to shell out the seed. In this way the immature seed is mixt with the ripe seed sown in the seed beds. In the seed beds the immature seed frequently sprouts earlier than the mature seed, and the early seedlings grown from such seed are naturally used for transplanting in the field. Such plants have a great tendency to vary, in some cases being very early, and as a rule having leaves that are small, coarse, and wholly undesirable for any purpose. These weak, immature tobacco seeds, according to careful and extensive observations by the writers, produce plants which are more subject to certain diseases, particularly the mosaic disease, than are plants grown from mature seed.

The excess of plant food in the soil where heavy applications of barnyard manure and commercial fertilizers are used is usually thought to produce variations in the plants. This variation is usually shown by an increase in the size of the leaves, which is generally correlated with changes in color, flavor, and other characters. In these cases there is usually a tendency for the type of plant to break up, so that the uniformity of the crop is disturbed. Where it is necessary to use large quantities of fertilizers in the growing of a profitable crop, the inclination to variation induced by this intensive system of cultivation must be controlled by the most rigid selection of seed from the type of plants best adapted for the purpose for which the tobacco is grown.

The change of soil and climatic conditions, particularly the taking of tobacco seed from southern or tropical conditions to the north, is a fertile source of variations in tobacco. The fixation of a uniform type in this case requires several years of acclimatization, supplemented by selection of seed from the desirable plants.

In the production of improved varieties of tobacco by breeding, variation in type can be secured by crossing, and by continued saving of self-fertilized seeds from plants most nearly reaching the growers' ideal of perfect plants uniform types can be fixt. Growers will frequently find plants that are markedly better than the rest of the plants in the field, so that by selecting these desirable variations a steady improvement in the yield and quality of the crop can be effected. Variation, therefore, is a basis for selection in an experimental way, but in practise every effort must be put forth in order to secure uniformity of the plants in the field and thus produce the most profitable crops.

The variations in tobacco plants may be divided into two general classes—variation in type and individual variability within the type. The causes of the variations in type, or striking variations, include crossing and change of soil and climatic conditions, particularly the change of seed from the Tropics to temperate regions. The causes of individual variations within the type include the fortuitous variations or inherent tendency to variability, methods of soil fertilization and cultivation, maturity of seed, and various local conditions. With an understanding of these conditions the grower can to a great extent control the degree of variability by methods of saving seed, systems of cultivation, and other practical methods of culture.

THE INTRODUCTION AND ACCLIMATIZATION OF VARIETIES.

The introduction of the seed of standard foreign-grown varieties of tobacco has been the source of increased wealth and prosperity in certain tobacco districts of the United States. In other regions such importations have resulted in great financial loss to the growers, which in most cases has been due to a lack of knowledge of the effect of the change of soil and climatic conditions on the particular type of tobacco grown. The writers have had an unusual opportunity in the course of their work to observe the behavior of crops grown in different tobacco-growing sections from imported seed, and have conducted extensive experiments in taking seed from one district to another, with a view to securing definite information on this subject for the benefit of the growers. The results of these observations are presented here for the guidance of tobacco growers who desire to use foreign-grown seed or who wish to change their seed.

The western Florida and southern Georgia Sumatra tobacco industry is an illustration of the successful introduction of a foreign-grown variety of tobacco. Tobacco growers in this region secured small samples of the seed of the Sumatra variety of tobacco from the island of Sumatra. At first small experimental crops were grown and seed saved from the best plants in these crops. In the course of this experimental cultivation it was noticed that the plants grown under the partial shade of trees in freshly cleared fields produced finer and more desirable leaves for cigar wrappers than the plants grown in the open. This fact led to the erection of an artificial shade over the fields, made of slats laid on a suitable framework. This method of growing tobacco was introduced about 1896 by Mr. D. A. Shaw, of Quincy, Fla. Later, other growers used a coarse cheese cloth as a substitute for the slats. The shade method of growing tobacco in this region has developed rapidly, and at the present time several thousands of acres of tobacco are grown under either slat or cloth shade, and the industry has become established on a profitable and successful basis. During this time considerable attention has been paid to the production of a uniform type of tobacco adapted to the climatic and soil conditions of this section by the saving of seed from carefully selected plants of the Sumatra variety.

When Sumatra seed was first introduced into Florida the variety broke up into a number of different types, some of which were desirable, while others were undesirable. By reason of the small crops grown from such seed, the loss to the growers from the production of undesirable types of plants was not very great. The growers naturally saved for seed those plants which produced the most desirable types of tobacco, and as a result of continued selection of this kind a fairly uniform type of tobacco which was adapted to the local conditions in this section was secured. As the demand for this Florida-grown Sumatra tobacco developed, resulting in increased acreages, seed was at hand which was thoroly acclimatized for planting the larger area devoted to this crop. From time to time the tobacco planters in this region have obtained small quantities of seed from Sumatra, but in such cases this seed has been grown in a very limited way in very small fields until it has been acclimatized and uniform types have been secured by seed selection.

About the time of the Cuban revolution it became apparent that the supply of Cuban-grown tobacco for the use of cigar manufacturers in the United States might become limited by reason of the unfavorable conditions for tobacco growing then prevailing in Cuba. Under these circumstances it was thought to be a propitious time to introduce the growing of Cuban tobacco into southern Florida, where the conditions of climate and soil were believed to be similar to those of Cuba. Considerable public interest was aroused in this project, and as a result large quantities of Cuban-grown seed were secured and planted in certain sections of Florida. The crops raised from this seed proved to be a disappointment to the growers. The change of soil and climatic conditions resulted in the breaking up of the type of the Cuban variety into a large number of sorts, some of which were desirable, while others were undesirable. Many of the plants developed a branching habit of growth, bearing very small, undesirable leaves of poor quality, resulting in a very low yield of an inferior tobacco. One of the main causes of failure was the lack of understanding on the part of the growers of the effect of the change of conditions on the type of tobacco and their neglect to appreciate the necessity of securing strains of plants by seed selection of the desirable types adapted to the particular conditions of soil and climate in southern Florida. If the acclimatization of these strains had been accomplished by seed selection in small fields, with little loss to the growers, the strains could have been grown on a more extensive scale with better chances of success.

In order to illustrate the necessity for the acclimatization of a variety of tobacco before it is grown on an extensive scale, the successful experiments of the Bureau of Soils in the introduction of Cuban tobacco in Texas may be cited. After a previous unsuccessful attempt by farmers in Texas to grow Cuban tobacco from freshly imported Cuban seed the Bureau of Soils began systematic experiments in growing small fields of tobacco and saving the seed of the most desirable plants according to the method described in this bulletin. In these crops certain plants were found which produced leaves possessing the flavor and aroma desired in a high-grade filler tobacco. The seeds from these plants were saved under bag, and their product has been found to possess the desirable characters of the parent plants. This tobacco has been sold at profitable prices, and the area devoted to the growing of this crop is being gradually extended in order to meet the demands of the manufacturers for this grade of filler tobacco. In northern Florida the tobacco growers, as a result of their experience with the imported Sumatra seed, experimented in growing, in the open, small fields of a cigar filler tobacco of a variety the seed of which was originally introduced from Cuba. This variety of Florida filler tobacco is now being grown extensively and profitably in that section.

The best illustration of the effect of a change of climatic and soil conditions upon the character of a variety of tobacco is found in the experience of tobacco growers in the Connecticut Valley in the planting of Florida-grown Sumatra seed and seed of the Sumatra variety imported from the island of Sumatra. As discust in an article upon the improvement of tobacco by breeding and seed selection in the Yearbook of the Department of Agriculture for 1904,[a] tobacco growers in the Connecticut Valley in the seasons of 1901 and 1902 grew extensive crops from seed introduced from Florida and Sumatra. In a careful examination of these fields it was found that the change in conditions had resulted in the breaking up of the type of the variety, so that several distinct types of tobacco were found growing in the same fields. Some of these types of plants produced well-rounded leaves, with fine venation and the elasticity, strength, gloss, grain, and other characters necessary in a high-grade cigar wrapper tobacco. However, many of the types of plants produced long, narrow, coarse, pointed leaves, wholly unsuited for cigar wrapper manufacture. In the case of another inferior type it was found that the leaves would not burn, altho the remaining characters were those of a desirable grade of tobacco. It was impossible to sort out this type, even by the most careful inspection of the crop, and, as a result, when the manufacturers wrapt cigars with leaves of this type and found that the wrapper would not burn, the quality of the entire crop was condemned. Certain other types of plants produced leaves of such thin texture or light body that when wrapt on cigars and allowed to dry out the wrapper frequently broke, or when the consumer carried the cigars in his pocket the wrappers were easily injured.

---

[a] Shamel, A. D. Yearbook of the Department of Agriculture, 1904, pp. 435–452.

One of the most striking types of plants produced in the crops grown from this imported seed was the Belgian type, an illustration of which is shown in figure 1. In this case the plants bore leaves measuring from 30 to 46 inches long and only from 5 to 10 inches wide. These leaves, as shown in figure 2, were very pointed in shape, with coarse, angular veins, and as the cured tobacco lacked the appearance necessary for a cigar-wrapper tobacco its production was a total loss to the growers. The variation in type was accompanied by differences in time of maturity, so that the cost of the growing and harvesting of these crops was greater than in the case of uniform crops. The mixture of types was accompanied by great variation as regards the individual plants of each type. In many cases plants bearing 25 leaves were found growing by the side of plants producing 10 leaves. Marked variations in size and shape of leaves and in the number of suckers borne by the individual plants were observed, and as a result it was found that the comparatively small number of desirable types could not make up for the loss in the production of undesirable and worthless grades of tobacco. As a natural consequence of this condition the extensive culture of this variety of tobacco from imported seed has been abandoned, and the grow-

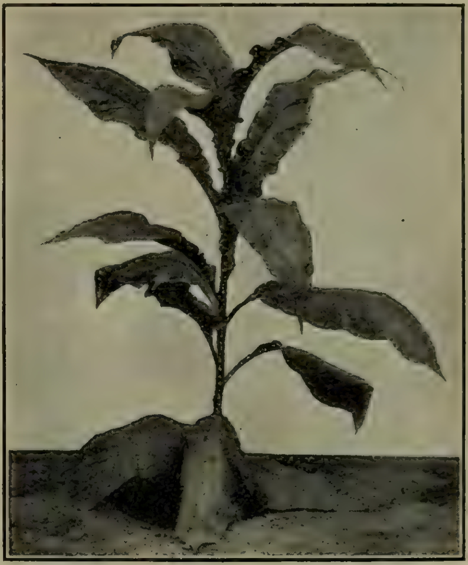


FIG. 1.—Belgian type of Connecticut Sumatra tobacco plant. These long, narrow leaves with oblique veins, coarse texture, burn very poorly, and after curing light green color are almost absolutely worthless for cigar-wrapper purposes. This type appeared in crops grown in the Connecticut Valley from Florida-grown Sumatra seed.

ers now have small fields and are selecting those plants producing the most desirable grade of cigar-wrapper tobacco with a view to securing strains which are adapted to the conditions of the Connecticut Valley. In the experimental fields of the Bureau of Plant Industry, covered with cloth shade, where seed of desirable plants has been saved under bag for three seasons, uniform strains, which are absolutely free from the unusual or distinct types observed in the fields from which the original selections of seed were made, have been produced.

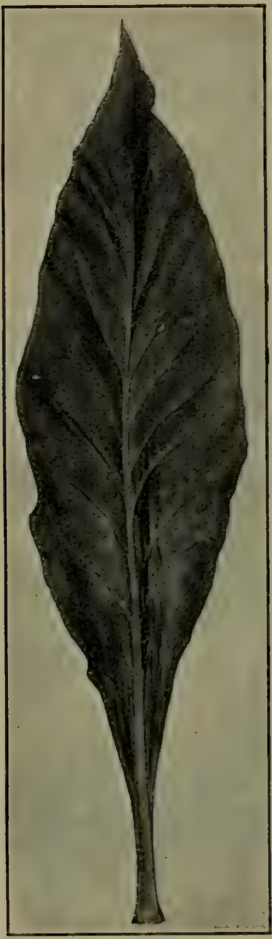


Fig. 2.—Typical leaf of Belgian type of tobacco, showing the characteristic shape, venation, and other characters of this variety which are wholly unsuited for cigar-wrapper manufacture. The presence of such types of leaves reduces the value of the crop and is detrimental to the reputation of the variety of tobacco in which they are produced.

A few of the growers of the Sumatra variety in the Connecticut Valley introduced Cuban-grown seed and used it for planting their general crops. In these fields the breaking up in type was not so noticeable as in the case of the Sumatra variety, but the effect of change of conditions in the variety was shown in the production of so-called freak plants. These plants had a branching, or suckering, habit of growth, bearing very small, sharply pointed, coarse leaves that were worthless for cigar-wrapper purposes. In a careful study of the plants in these fields it was found that at least one-third of the entire crop consisted of these freak plants.

In one of these fields the writers made selections of seed plants of the most desired type, bearing the size, shape, and general character of leaves adapted for cigar wrappers. This seed was saved under bag, and a similar plan has been followed up to the present time.

In Plate I, figure 1, the original crop raised from freshly imported seed from which the seed selections were made is shown. In Plate I, figure 2, is shown a crop grown on the same field after two generations during which the seed was saved under bag. As can be seen from the illustrations, this method of seed selection and bagging has produced a uniform type of tobacco without the freaks and other undesirable types of the original crop. It is fortunate that on this farm the planter saved seed in the open for his own use from the same field. The crop grown from such seed was visited during the season of 1905 by the writers, in company with Dr. H. J. Webber and several tobacco growers, and was found to contain a large proportion of freaks; in fact, about the same proportion as the crop grown from freshly imported seed. In other words, the seed saved under bag produced uniform strains adapted to soil and climatic conditions in this section, while seed saved in the open and subject to cross-fertilization with freaks and other undesirable types produced about the same proportion of freak plants as the crops grown from the freshly imported seed.

The writers during the past season planted in Florida Connecticut-grown seed of the Sumatra variety. It was found that while there was a noticeable change in the shape of leaf and in some minor characters in the Florida-grown tobacco, there was no violent breaking up of type or indication of unusual variability. This experiment and other observations have led the writers to believe that the effect of changing seed from the north to the south is not accompanied by such marked changes as when seed is taken from tropical conditions to northern latitudes.

In summing up the observations on this subject it can safely be said that it is a dangerous policy to plant large crops of tobacco with imported seed or with seed from a very different section. In most cases it has resulted in failure and caused considerable loss to the growers. The general crops should be planted from seed produced under the same conditions as the crop which is to be grown. If it is necessary to change the seed or desirable to test imported varieties, it should be done on a small scale, followed by a most careful selection of seed plants, and the seed should be saved under bag, safe from cross-fertilization.

THE STRUCTURE AND ARRANGEMENT OF FLOWERS.

A careful study of the tobacco flower is one of the most essential factors in the beginning of tobacco breeding. Successful results, particularly in the production of new varieties, can seldom be obtained until one becomes familiar with the structure of the parts of the flower and the manner in which these parts perform their several functions. A full realization of the ease with which crossing takes place can only be obtained in this way, and, as has been previously stated, the prevention of promiscuous cross-pollination is of first importance in the production of a desirable and uniform type of tobacco.

The tobacco flowers are arranged upon a branching determinate flower head, which appears when the middle leaves are about half grown and continues to develop and produce new flowers during the rest of the life of the plant. Figure 3 is a diagrammatic sketch of a tobacco flower, showing the parts of the flower and the general way in which pollination takes place. The calyx (*a*) is the outer, green, five-parted, floral envelop at the base of the flower which serves to protect the flower in the bud. The corolla (*b*) is the delicately colored floral envelop inclosing the reproductive organs of the flower. Its color tends to attract insects, which are the principal agents in cross-pollination. Next inside the corolla are the five stamens, which are the male reproductive organs of the flower. Each stamen consists of the filament (*i*), supporting the anther (*j*) in which the pollen grains (*k*) are produced. The central organ is the pistil, or female part of the flower. The terminal enlarged portion (*g*) is the stigma. The pollen grains (*k*) adhere to the surface of the stigma (*g*) and germinate, sending an extremely minute tube (*l*) down thru the central conductive tissue (*h*) of the style (*f*). This tube extends into the cavity of the ovary (*d*) and finds its way into the ovule (*n*) thru a small duct or micropyle (*m*), where fertilization takes place. Other ovules (*e*) are fertilized by other pollen tubes. These ovules develop into seeds after fertilization. The ovary is two-celled, with a fleshy central placenta (*c*) on which the ovules are borne. The early capsules mature always before flowering ceases. The shape of the delicately colored corolla is somewhat tubular, or, perhaps, more nearly like an elongated funnel. It is comparatively small from the basal end to a point about two-thirds the distance to the terminal end of the flower. At this point it enlarges suddenly to more than twice the size of the basal part of the tube (fig. 3). It is composed of 5 petals, which coalesce to form the corolla tube, and separate only at the extreme end.

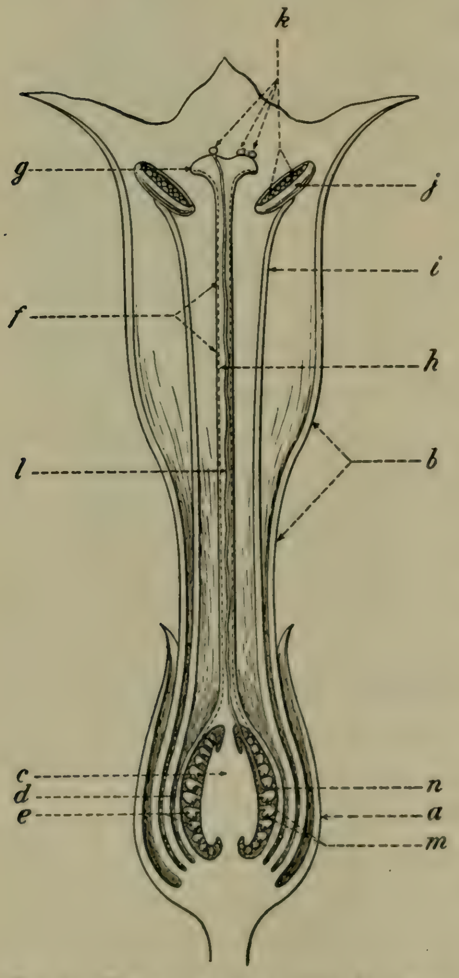


FIG. 3.—Diagrammatic sketch of tobacco flower.

The tobacco flower is symmetrical. The number of sepals and stamens is always the same as the number of petals, but these floral circles do not remain constant, varying rather indefinitely in different strains and even among individuals of the same strain. Trimerous flowers, or flowers with three parts in each flower circle, have been found growing on the same plants with pentamerous flowers, or those having five floral parts. This is the exception, however, and not the rule.

The tobacco flower is naturally self-fertile, and plants grown from self-fertilized seed are always stronger and more vigorous than those from cross-pollinated seed when the crossing is within the variety. In Sprengel's discourse on the cross and self pollination of plants the statement is found that "nature seems to have wished that no flower should be fertilized by its own pollen." Later, Darwin stated that "nature abhors perpetual self-fertilization," but, unlike Sprengel, recorded a number of exceptions to this rule, and tobacco was among them. The experiments of the writers conclusively substantiate the findings of Darwin in this connection. They have found self-pollination in the case of tobacco to be most desirable in all cases.

A very interesting phenomenon of growth takes place in the filaments of the stamens immediately after the opening of the flowers, which can be taken as an evidence of the natural self-fertilizing habits of the plants. An examination of the flower just previous to the time of opening will reveal the fact that the pistil is longer and extends up beyond the stamens, but when the anthers open and the stigma becomes receptive a very rapid growth of the filaments takes place, which causes the open pollen sacks to be pushed up past the stigma, and in almost all cases they come in direct contact with the stigma in passing upward. This gives an opportunity for at least a portion of the pollen grains to adhere to the viscous surface of the stigma and for self-fertilization to take place, as shown in figure 3. It is just before this process occurs or while it is in progress that there is danger of, or opportunity for, cross-pollination. The open flower contains a small drop of nectar at the base of the corolla tube, which is sought by honeybees, bumblebees, and humming birds, as well as by many species of minute insects, all of which carry pollen from flower to flower and from plant to plant in their constant search for the honey-like substance secreted in the corolla tube. In passing in and out of the flowers the bodies of the bees and other insects and the beaks of the humming birds become dusted with pollen, which is transported by them to the pistils of the next flower visited. The ovules are as readily fertilized by pollen from the surrounding plants as by the pollen from the flower in which they are produced. This continuous crossing necessarily results in the introduction and intermixture of poor and undesirable varieties in our best strains of tobacco.

The observations of the writers plainly show the absolute necessity for protecting the flowers of the seed plants from cross-pollination. Careful experiments have demonstrated that in many instances the stigma of the tobacco flower remains in a receptive condition for three or four days. This condition results in a twofold disadvantage when no protection is used against cross-pollination. In the first place, it affords abundant time and opportunity for complicated crossing, for each flower is visited many times a day by various insects and often by humming birds; and, secondly, it brings about conditions favorable for the production of seed of weak vitality. Previous experimenters have pointed out the fact that the best seed is not produced as a result of premature or late pollination, either of which is likely to occur in the case of tobacco flowers under natural conditions. When fertilized only by pollen of the same flower, the pollination takes place at exactly the right time, or when the stamens push past the receptive stigma, which results in the production of a superior grade of seed.

The readiness with which tobacco flowers can be cross-fertilized greatly facilitates the opportunity for producing new and valuable varieties by artificial crossing. In the course of the experiments here recorded it has been found perfectly possible to combine certain desirable qualities found in different strains and at the same time to eliminate some of the undesirable characters by producing hybrids between strains of tobacco.

The method of cross-pollination used in the experiments of the writers is to remove all capsules, open flowers, and flower buds from the flower head except those which are in the proper stage of development to open within the following twelve or fifteen hours. In preparing these remaining flowers they must be carefully opened and emasculated by the use of a scalpel, small scissors, and a fine pair of forceps, as illustrated in figure 4. Great care must be taken in removing the anthers before they have dehisced, in order to avoid injury to the stigma. The emasculation should be done in the afternoon, after which all of the flowers must be carefully covered with a thin paper bag as a protection against insects or other agencies whereby pollen might be transferred to them. In the forenoon of the following day the emasculated flowers should be ready for pollination, but the exact time for applying the pollen must be determined in the case of each individual flower by the appearance of the viscid, sticky fluid on the surface of the stigma. The pollen from the male

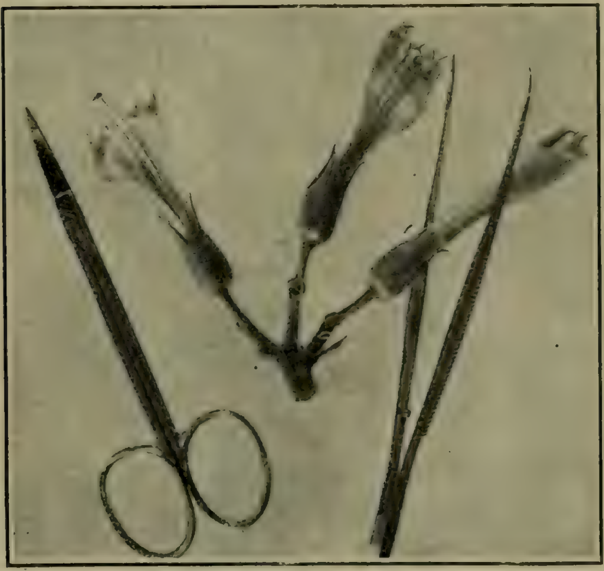


FIG. 4.—Three tobacco flowers at proper stage for emasculation, and the scissors and forceps used in emasculating flowers. The corolla of the central flower has been opened in order that the anthers may be conveniently removed. The flower on the left has been emasculated preparatory to cross-pollination.

parent plant can be best applied to the stigma of the female with the point of a scalpel or other sharp instrument. When applied with a brush there is danger of some of the pollen grains adhering to the hairs of the brush after each operation, resulting in considerable mixture of pollen, but where the scalpel is used there is no difficulty in removing all the pollen after each operation. The paper bag must be replaced over the flowers as soon as they have been pollinated, and must be allowed to remain until the seeds have set and all danger of crossing has past.

In crossing it is not essential that both of the parent varieties be grown in the same community. Pollen from tobacco flowers when thoroly dry will keep for several weeks or longer without deterioration. The writers have sent pollen thru the mails a distance of more than a thousand miles with perfectly satisfactory results. When not intended for immediate use, it should be harvested when perfectly dry and carefully taken off the anthers after they have dehisced and become dried out. These dry anthers may be put in small vials, and the pollen kept long enough for all practical purposes, provided the vials are carefully corked and kept dry.

The large number of seed produced in a single pod and on a single plant makes it possible to obtain definite results from selection or hybridization in tobacco much more quickly than in the case of most other plants. Careful counts show that from 4,000 to 8,000 seeds are produced in a single pod of normal size, and an estimate of the average number of pods on each plant shows that the ordinary tobacco plant produces from 500,000 to 1,000,000 seeds. In many cases the writers have secured from 1 to 1½ ounces of seed from a single plant when the seed has been saved under bag according to the method outlined in this bulletin. This large number of seeds gives an excellent opportunity for testing each selection or cross on a large scale. The quantity of seed produced varies inversely with the number and size of leaves on the plant. The production of a large number of good-sized leaves is almost invariably accompanied by the production of a small quantity of seed.

On account of the large quantity of seed produced by a single plant under normal conditions and the fact that the various characters of a tobacco plant are inherited so strikingly and uniformly by its progeny the following year when the seed is saved under bag, protected from cross-fertilization, it is possible for the tobacco grower to secure uniformity with a considerable degree of improvement in type, quality, and yield by one year's selection. One plant often furnishes enough seed for an entire crop, and the plants raised from this seed always produce a very uniform lot of tobacco when cross-fertilization is not allowed to take place.

THE NECESSITY FOR INBREEDING.

In the season of 1903 the writers, in company with Dr. H. J. Webber, visited the tobacco fields of the Connecticut Valley in response to a request of the growers for assistance in the production of uniform strains of tobacco by breeding and seed selection. During the survey of this region with a view to gaining an idea of the variability of the varieties of tobacco, it was determined to inaugurate a series of experiments in a practical way for the investigation of the methods of saving seed.

In view of the results of the investigations of Darwin and others on the comparative vigor of growth, seed production, and other characters of tobacco plants raised from seed obtained by cross and by self fertilization [a] the seed of select plants of the different types of tobacco was protected from cross-fertilization by inclosing the flower heads with a light but strong form of paper bag. Other seed plants were saved without such protection, as is ordinarily done by the tobacco growers. The seed harvested from these seed plants was saved separately, stored in small glass vials adapted to this purpose, and labeled according to the system now in use by the breeders in the plant breeding investigations of the United States Department of Agriculture. The record of the number of leaves, size, thickness, shape, and color of leaves, number of suckers, height of plant, habit of growth of leaves and plants, time of maturity of leaves and seed, and other characters was kept according to the system used by Doctor Webber, modified by the writers for use in keeping a pedigree of tobacco varieties.

The seed of the plants finally selected for experimental purposes was sown in ordinary seed beds, separated into many small sections by thin board partitions, each of which was capable of holding 500 seedlings. The seedlings from these separate seed-bed plats were transplanted to separate rows or plats in the experimental field, each row or plat being carefully labeled so that the plants could be traced directly back to the original seed plants. The manuring, or fertilization, and preparation of the soil in the experimental field and the transplanting, cultivation, and harvesting of the plants were all conducted with the greatest possible care to give all of the rows or plats equal opportunity for growth. For instance, the seed of all of the plants of a variety was sown the same day, and at the proper time the seedlings of this variety were all transplanted the same day. At the time of harvest the leaves of the individual rows or plats were primed or the plants cut on the same day, and the leaves or plants were hung in the curing shed, so as to get as nearly uniform conditions for curing as were consistent with the practical handling of the crop. The leaves of plants selected for seed were harvested separately and labeled so that the product of each plant could be intelligently used in comparative tests of the cured and fermented crop. This labeling process involved considerable extra work and attention in the field, curing sheds, and warehouses, but was absolutely necessary for a definite selection of seed plants for the next season's use, based on the character of the fermented tobacco.

---

[a] Darwin, Charles. Cross and Self Fertilization in the Vegetable Kingdom, pp. 203–215.

The rows or plats of plants grown from seed of individual plants saved under bag, i. e., self-fertilized seed, showed remarkable uniformity in type, size, shape, and appearance of leaves, habit of growth, and all other characters, and conformed closely to the type of the parent plants from which the seed was saved.

Plate II, figure 1, shows a type of parent plant and Plate II, figure 2, the progeny of this plant, raised from self-fertilized seed. From this illustration it can be seen that the transmitting power of tobacco is most strongly marked and the progeny of plants raised from inbred seed remarkably uniform in all characters, every plant closely resembling the parents. In the hundreds of tests of this character which have been carried on by the writers during the past three seasons, not only in the Connecticut Valley but in Maryland and Florida, the benefits to be derived from using inbred tobacco seed have been confirmed and emphasized. It is true that some plants have the power of transmitting their characters to their progeny more strongly than others, but on the whole every case under observation has offered additional evidence of the value of the practise of saving tobacco seed under bag, free from possible cross-fertilization.

The continued saving of self-fertilized seed for three seasons has furnished no evidence of a decrease in the rate of growth or constitutional vigor of tobacco plants as a result of this practise. On the other hand, by reason of the selection of the best plants in the different varieties every season there has been a marked increase in the productiveness and the general vigor of constitution of the varieties under consideration. This conclusion is emphasized by the vigorous and productive strains of Connecticut tobacco shown in Plate III.

Self-fertilization is the closest possible degree of inbreeding, and it is the general impression that this practise is usually associated with a loss of vigor of growth, with a predisposition to disease, and other undesirable results. In tobacco, so far as our experience goes, this does not happen, and the exact opposite of this condition obtains, viz, that inbreeding is beneficial to the general development of the variety.

It is unfortunate that it is impossible to present tabular data at the present time showing the behavior of plants raised from artificially cross-fertilized seed within the variety in comparison with plants raised from self-fertilized seed. The principal object of this work has been the achievement of practical results, so that the opportunity for scientific observations and experiments has been necessarily limited. However, the writers have had the privilege of making careful observations on the results of saving seed from plants grown under large field tents and comparing the plants raised from such seed with the plants raised from self-fertilized seed. Under these tents there is little opportunity for cross-fertilization with other varieties, except thru the small doors opening into these tents, which are kept closed all of the time when persons or teams are not actually passing thru them, so that there is little likelihood of bees or other insects passing in and out. The probability is that the cross-fertilization that takes place is wholly between the plants saved for seed in these tents or with other plants under these shades that are in bloom at the proper time for cross-pollination.

The comparison of the plants raised from seed saved under these field tents and exposed to cross-fertilization with the surrounding plants and of plants of the same variety raised from seed protected from cross-fertilization by paper bags shows that self-fertilized seed produces more uniform, vigorous, and productive plants than the open-fertilized seed, which is to a greater or less extent cross-fertilized between plants of the same variety.

It appears that the cross-fertilization of tobacco seed, even tho it occurs between good individuals, has a tendency to seriously break up the type. Along with the variability of type induced by cross-fertilization, it frequently happens that many freak plants resembling the wild species appear; these can only be explained with our present knowledge of the subject as reversions. Such freak plants are not usable for profitable manufacture, and consequently are a source of loss to the growers.

The size and weight of seed from the inbred plants are equal to and in most cases greater than the seed saved from open-fertilized plants. In a series of comparative tests of the two kinds of seed in the case of four varieties grown in the Connecticut Valley it was found that the inbred seed was heavier and larger than the cross-fertilized seed. The total quantity of seed harvested from the open-fertilized plants usually exceeded that of the inbred plants. This was due to the fact that in the case of the inbred plants more of the seed-bearing branches were removed than where the plants were allowed to set seed under natural conditions, in order to adapt the seed head for the best possible development under the paper bags. Where an equal number of seed pods was examined for yield of seed the inbred seed equaled or exceeded in quantity the cross-fertilized seed in the variety. In the case of hybrids or in the crossing of two distinct strains or varieties the yield of seed, as well as rate of growth of the hybrid plants, was greater than that of the inbred seed and plants. It is true that some of the improved inbred strains produce but little seed compared with unimproved types of the same variety. Inbred strains have been selected for increased yield and number of leaves, which seem to be correlated with lessened seed production. The same correlation holds true where open-fertilized strains have been selected for increased number and total yield of leaves.

The rate of germination of the inbred in comparison with the cross-fertilized seed was thought to be slower in some of the experiments carried on in the season of 1904. However, further comparisons have failed to bear out this conclusion, and it is the belief of the writers, based on careful observations on this subject, that the inbred seed sprouts as rapidly as the cross-fertilized seed. It seems probable that in the cases observed by growers in 1904 a difference in moisture content of the rotted apple-tree fiber, the medium used for sprouting, was the cause of the apparent differences in time of sprouting. So far as the writers' observations go, the inbred seed produces more rapidly growing plants than the open-fertilized seed, and consequently earlier plants for transplanting. There is no doubt, further, that the inbred seed produces a larger proportion of seedlings for transplanting at one time than the open-fertilized seed, which is an important matter to the tobacco grower, who is frequently forced to wait for seedlings on account of the lack of uniformity of plants in beds sown with open-fertilized seed.

Darwin's conclusions on the comparison of tobacco plants raised from inbred and cross-fertilized seed for three years are as follows:[a]

> Taking the plants of the three generations altogether, the crossed show no superiority over the self-fertilized, and I can account for this fact only by supposing that with this species, which is perfectly self-fertile without insect aid, most of the individuals are in the same condition as those of the same variety of the common pea and of a few other exotic plants which have been self-fertilized for many generations. In such cases a cross between two individuals does no good; nor does it in any case, unless the individuals differ in general constitution, either from so-called spontaneous variation or from their progenitors having been subjected to different conditions. I believe that this is the true explanation in the present instance, because, as we shall immediately see, the offspring of plants which did not profit at all by being crossed with a plant of the same stock profited to an extraordinary degree by a cross with a slightly different subvariety.

---

[a] Darwin, Charles. Cross and Self Fertilization in the Vegetable Kingdom, p. 210.

These conclusions of Darwin were based upon greenhouse and garden tests, where, of course, it was not possible to study and compare the characters of quality or the value of the tobacco from the inbred and cross-fertilized seed. The observations of the writers upon tobacco grown in the field under normal conditions in the different tobacco-growing sections bear out the conclusions of Darwin on this subject, and show, further, that the inbred seed produces more profitable crops of tobacco than the seed resulting from open or cross fertilization within the variety.

THE IMPROVEMENT OF THE SHAPE OF LEAVES.

The shape of the leaves is a very important factor in determining the value of all classes of tobacco, and is of first and particular importance in cigar-wrapper varieties. Many varieties which possess some of the most desirable characteristics of high-grade wrappers are totally valueless for this purpose on account of the narrowness of the leaves. From such leaves it is impossible to cut cigar wrappers economically. The manufacturer of cigars demands a leaf which is wide and well rounded at both ends. This shape admits of the best opportunity for cutting into wrappers of the desired shape and size with the least possible waste, while the long, pointed leaf will yield very few wrappers, and a very considerable proportion of it must be consigned to the waste pile.

The long, pointed leaf is not only undesirable because of its shape, but the texture toward the basal end is poorly adapted for cigar wrappers and the grain is usually unevenly distributed. In such cases a large part of each leaf can be utilized only for binders or low-grade fillers. A striking example of leaves of this character may be found in the case of many strains of Connecticut and of Pennsylvania Broadleaf varieties. When working these varieties the manufacturer expects to cut wrappers from the middle portion and tips of the leaves only, while the remainder of the leaves, often half or more, must be used as binders or for filler purposes. A wider leaf and one which is more nearly round would yield many more wrappers to the pound and would be proportionately more valuable.

In addition to being wide, with well-rounded tips, the best wrapper leaves must have small, fine veins which are widely separated and which form an obtuse or right angle with the midrib. The veins in narrow leaves extend along down the leaf toward the tip, are coarse, and present a very unattractive appearance when wrapt on cigars, while in the case of wide leaves the veins usually extend out toward the edge of the leaf and are almost perpendicular to the midrib, smaller in size, and wider apart. In some of the strains of

Broadleaf tobacco which have been improved by careful seed selection and breeding the veins are sufficiently wide apart to allow wrappers for cigars of standard size to be cut between the veins. Such wrappers have a very smooth, attractive appearance on cigars, and where they can be cut in this way the waste material from each leaf is exceedingly small. Figure 5 illustrates the superior value of the wide over the narrow form of leaf for cutting wrappers economically. Attention is also called to the character of venation in the two leaves shown. It will be observed that the veins extend out almost directly toward the edge of the leaf from the midrib in the case of the wide leaf (A), while in the case of the narrow leaf (B) the veins run upward, and, consequently, when used as wrappers injuriously affect the appearance of cigars.

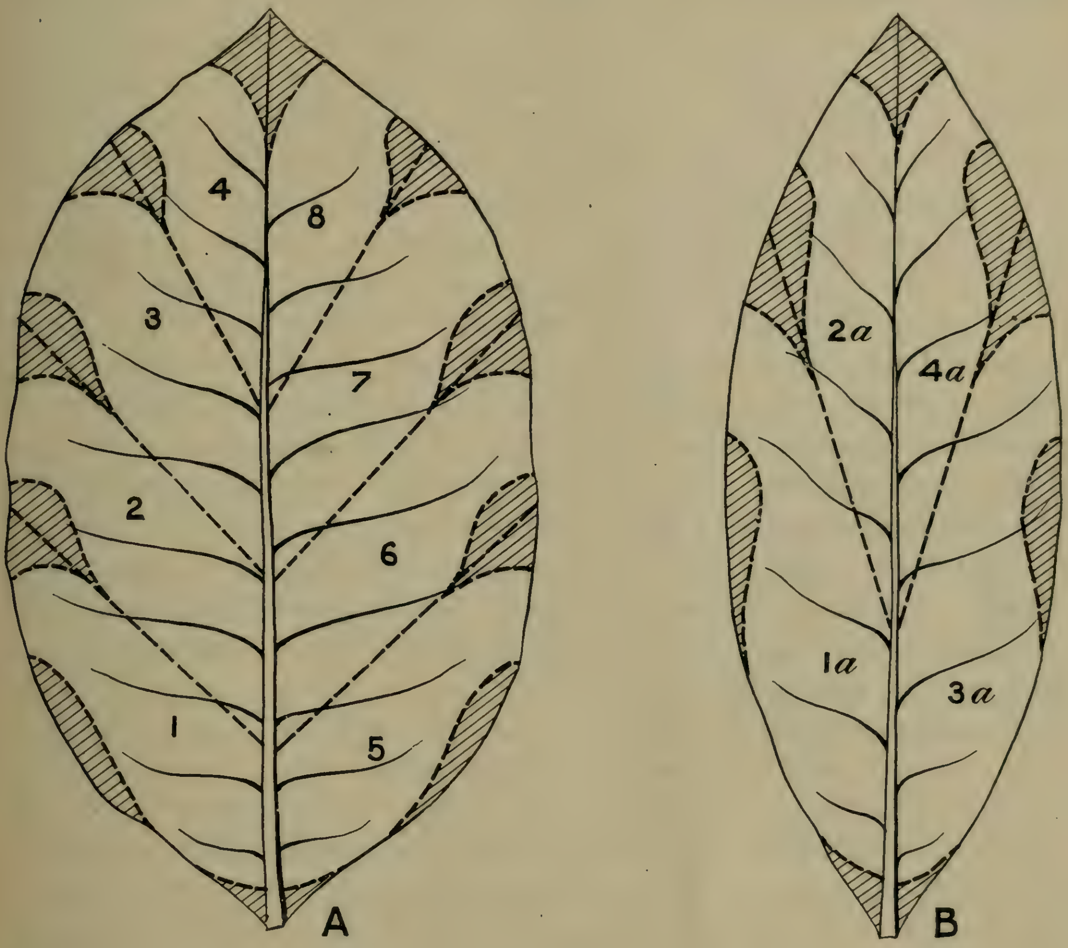


FIG. 5.—Diagrams showing the superiority of broad over narrow leaves for cigar-wrapper purposes: A, broad leaf; wrapper cuts numbered 1, 2, 3, 4, 5, 6, 7, and 8. B, narrow leaf; wrapper cuts numbered 1a, 2a, 3a, and 4a. Waste indicated by hatching. Not only do the broad, round leaves yield more cigar wrappers, but on account of the venation and other characters they produce wrappers of superior quality.

The variability of the plants in the field in respect to shape of leaf is found upon close observation to be more striking than the variability in many other characters. The variability of strains of tobacco grown from the seed of the same variety and under similar conditions as respects shape of leaves is shown in Plate IV. It is very important that this variability be reduced to the minimum, and the writers have found that it is possible to greatly reduce the variability by systematic seed selection. Plants producing leaves which are very long and narrow are frequently found growing beside others with well-rounded leaves of a desirable length. Plants bearing leaves of the ideal cigar-wrapper shape and those that were totally worthless on account of their shape, as well as many gradations between these extremes, have been found growing side by side. In the case of a field of Florida tobacco grown from freshly imported Sumatra seed a similar variability was observed in the summer of 1905. The production of leaves of undesirable shape results in a direct loss to the grower and manufacturer alike. The cost of production to the grower is no greater where the leaves are all of uniform size and shape, and the cost of grading is greatly reduced.

In nearly all varieties of cigar-wrapper tobacco, most of the leaves are small and narrow near the basal end and this portion of the leaf is seldom wide enough for wrapper purposes. Figure 5, A, shows a leaf wide at both ends, from which wrappers may be cut down to the extreme basal end, thus avoiding the waste which can not be avoided in the form of leaf shown in figure 5, B. It is important to produce the form of leaf shown in figure 5, A, not only because it will yield more wrappers to the pound and necessitate very much less waste in cutting, but because more wrappers to the acre may be obtained.

The variability in the shape of leaves on the same plant is often very marked, and may be as readily corrected by proper methods of seed selection as the variation among the individual plants in the field. The size and shape of the individual leaves on almost all plants vary more or less, but on some much more than others. An occasional plant will be found on which the leaves are comparatively the same size and shape from the top to the bottom of the plant, while in other cases there are marked differences in this respect. Where this uniformity is found the top leaves are seldom as thick or heavy as where there is a lack of such uniformity, and therefore a larger percentage of the leaves is adapted for cigar-wrapper purposes.

By selecting for seed the plants possessing leaves of the most desirable shape from top to bottom and protecting them from cross-fertilization, it is possible to produce a crop which will be uniformly like the parent plant. It can be plainly seen that this will result in a larger yield to the acre of much more valuable tobacco because of the uniformly well-shaped leaves, best adapted to cigar-wrapper purposes, and this may be accomplished with no additional expense to the grower.

The shape of the leaf in certain types of smoking tobacco largely determines its adaptability to both soil and market conditions. In Maryland it has been found generally true that a broad leaf gives best results on very light sandy soil, and is best adapted to the demands of the German market, while a somewhat narrower or longer leaf is more desirable on heavy clay soil; from this latter type the highest grades of red tobacco are produced to meet the requirements of the markets of France. In the case of Maryland tobaccos the shape of leaf is usually correlated with the number of leaves, there being more leaves to the plant where they are narrow than in cases where they are broad. The writers have observed many exceptions to this rule and have found that by keeping this point in mind when selecting seed plants it is possible to find round-leaved plants producing a large number of leaves, and to procure varieties from these plants which will produce a large number of uniform leaves and at the same time a grade of tobacco which will be adapted to the demands of the market for which it is grown.

It is within the power of the tobacco grower to produce the shape of leaf best adapted to the purposes for which his tobacco is grown, and to continually improve the shape and gradually bring it up to the ideal of a perfectly shaped leaf, by carefully selecting seed plants year after year which produce leaves most nearly approaching this ideal. In all cases if uniform types are to be produced cross-pollination must be prevented, in order that the progeny the following year may inherit only the characters of the desirable parent plants.

THE MODIFICATION OF THE SIZE OF LEAVES.

The modification and control of the size of tobacco leaves is of almost equal importance to the improvement of their shape, and the size is so intimately associated with the shape that both features can be dealt with along the same lines in the improvement of tobacco by breeding and seed selection.

The purpose for which the crop is grown must always determine the most desirable shape and size of the leaf, and the individual grower must decide for himself what size and shape will be best adapted to the local market demands. The importance of producing a comparatively definite and uniform size of leaf is well recognized by the manufacturers of all classes of tobacco. In the case of the Maryland Smoking tobacco grown for export purposes it is difficult to procure a leaf which is too large for the highest market demands, especially when it is grown for the French market. In most cases the leaves are too small. This defect may be remedied to a considerable extent by selecting for seed those plants which have the largest leaves, and at the same time this will result in a material increase in the yield of the crop. When grown for plug wrappers, the size of the leaf is as important and worthy of as careful consideration on the part of the grower as when grown for cigar wrappers. In the manufacture of certain brands of plug tobacco the entire side of the leaf is used for one wrapper, which method is often preferable to using large leaves which have to be cut into two or more wrappers. Where this system is followed, leaves are demanded which are comparatively narrow and of sufficient length to cover the standard size of plug with the least possible waste.

A careful study of the size of wrapper desired by the manufacturer will give the grower a very definite idea of the most desirable size of leaf to produce, and by selecting plants having this style of leaf for seed the grower is enabled to produce uniformly the type of tobacco which will be best adapted to his market conditions.

In cigar-wrapper varieties of tobacco the size is of as much importance as the shape of the leaf. A short, wide leaf is always the kind most in demand, and has the advantage of being much less susceptible to injury in the curing barn. The manufacturers of certain brands of cigars prefer to cut only two wrappers from each leaf, and for this reason demand a very small, round leaf. Most manufacturers prefer a leaf sufficiently large for cutting two or more wrappers from each side, for the reason that nearly all classes of cigar-wrapper tobacco may be used more economically in this way. The size of Sumatra leaf most desired at present is about 16 inches long and sufficiently wide to admit of the most economical cutting. When leaves become very much larger than this there is danger of coarse venation, altho this can be very largely controlled by selecting for seed only those plants which produce leaves that have small, fine veins.

The question of venation is very intimately associated with both size and shape of leaf, and a certain correlation seems to exist between these characters. The writers have been able to produce types having leaves of desirable shape and size in which the venation is fine and in every way desirable. The experiments that have been conducted with this end in view prove beyond a doubt that these important characters may be successfully correlated and largely controlled by methods of selection and saving seed.

In curing tobacco in the barn the size of the leaf has been found to be an important factor. This has been clearly shown in the breeding experiments in the Connecticut Valley during damp curing seasons. One of the objects sought in Connecticut has been to secure a shorter and rounder leaf than is now being produced in the Havana Seed and Broadleaf varieties. Numerous crosses have been made and hybrids produced with this end in view, and considerable progress has been made in securing a rounder leaf in the native varieties by careful seed selection. It has been invariably observed that these round-leaved varieties and strains have suffered much less injury from pole-sweat than the old standard varieties. This difference is attributed to the fact that in the case of the old long-leaf varieties the leaves after wilting hang down close around the stalk and adhere to one another, thus preventing the proper circulation of air when it is most needed for successful curing; while in the shorter, round-leaf types, the leaves stand out from the stalk, do not adhere closely together, and admit air freely to all the leaves on the plant, thus preventing in a large measure the injurious effects of pole-sweat or house-burn. The importance of the size of leaf from this standpoint can not be too strongly emphasized. The loss in the Connecticut Valley, as well as in many other sections of the country, due to pole-sweat often takes away the profit of the crop and is keenly felt by tobacco growers. The best crops are occasionally totally ruined by pole-sweat after they have been grown successfully and put into the barn in good shape. Therefore it can be plainly seen that the production of shorter, rounder leaved varieties in sections of the country where pole-sweat is disastrous will result in great profit to the tobacco growers and packers. Crops which have been badly injured in the barn are a source of endless trouble, and are very expensive to sort and pack successfully.

For cigar-filler purposes a comparatively small, short, and thick leaf is demanded. The small leaves are usually thicker and have better body and a very much better aroma and flavor than large, thin leaves. It has been definitely demonstrated from observations made by experimenters on the island of Cuba and from the observations of the writers made in certain filler districts of the United States that the best and most aromatic fillers are always obtained from plants producing comparatively small leaves. Plants which in a way seem to represent dwarf types or strains almost invariably produce leaves which have a much higher aromatic flavor than can be obtained from plants of the same variety producing larger and finer leaves.

In an attempt to improve the aroma of some of our domestic filler types thru breeding and selection the Department of Agriculture is endeavoring to produce new types of Cuban tobacco with very small leaves, with the belief that such types will have a superior aroma and will excel the filler grades which are now being grown in this country. These experiments have not advanced far enough to admit of any very definite conclusions, but they have indicated very clearly that it is possible to produce better fillers by originating and perpetuating small-leaved varieties of tobacco. The yield from such types has been comparatively small, but by setting the plants closer together it is believed that there will be very little decrease in the yield to the acre in the production of small leaves uniformly thruout the crop.

The great variation in the size of leaf which is found in nearly all tobacco fields makes it possible to breed up and fix varieties which will produce uniformly the size of leaf most desired to meet special market demands. Plants producing small leaves are found growing along with those producing large leaves when all are, as far as we know, of exactly the same variety and grow under equal and uniform conditions. This variation is undoubtedly due to promiscuous accidental cross-pollination which has taken place in preceding generations. This variation in size as in shape of leaf also occurs much more strikingly on some individual plants than on others. Plants may be found in all tobacco fields with leaves of comparatively the same size and shape from the top to the bottom of the stalk, while in the majority of instances they are much smaller near the base and top than the middle of the stalk. By selecting seed plants that produce leaves which are uniformly of the desired size and shape from top to base of plant and by covering the flower heads with light paper bags, leaves very uniform in this respect may be grown the following year from seed saved in this manner.

Any tobacco grower will recognize immediately the advantages to be gained by producing types of tobacco in which the leaves on all of the plants are uniform in size and shape and where the leaves on the individual plants are likewise uniform in this respect from the top to the bottom of the plant. The yield of the crop will be materially increased, as will the value of the tobacco, while the cured product from such fields will be much more uniform in the packing house and the cost of handling proportionately reduced. The writers have already secured striking uniformity in some of the best strains of cigar and smoking tobaccos grown from seed which they have selected carefully and systematically for three years, and have found a considerable increase in the yield and value of the crop grown from such varieties.

A recognition of the importance of producing this uniformity is emphasized by the great number of demands made upon the writers for seed of these improved strains. It is easily within the power of tobacco growers to improve their present strains of tobacco in the shape and size of leaf, as well as in other characters, by selecting for seed the plants which are most nearly perfect in these respects and by saving the seed under bag according to the methods outlined in this bulletin, in this way preventing intermixture with undesirable strains by accidental cross-pollination.

THE CONTROL OF THE NUMBER OF LEAVES ON INDIVIDUAL PLANTS.

The variation in the number of leaves borne by individual plants is just as marked as the variation in size and shape, but the size and shape are not always correlated with the number of leaves. In a general way it has been the observation of the writers that in cigar-wrapper tobaccos the plants which produce the best-shaped leaves usually produce more than the average number of leaves. The variation in the number of leaves on individual plants grown in the same field may be almost invariably attributed to the lack of systematic seed selection, to crossing, and to the use of a large proportion of light, weak seed in planting. The variation may be correlated with the height of the plants or the length of the internodes, or both. Different strains of the same variety are extremely variable in respect to the number of leaves produced, and until pure strains are developed no very great degree of uniformity in the number of leaves borne by individual plants in the crops may be expected. The production of strains true to type and uniform in the number of leaves, as well as other characters, is made possible by the careful selection of seed.

The control of the number of leaves is directly associated with the yield of the crop, and bears a very important relation to success in the handling and curing processes. The possibility of procuring a larger number of desirable leaves on each plant thru careful selection of seed is no longer doubtful, as is clearly borne out by experiments in tobacco breeding. An increase in the production of leaves borne by individual plants has been effected without any increase in the height of the plants and with no detriment to the quality of the tobacco. The reduction in the height of the plants is especially important in Sumatra tobacco grown under shade. It is difficult to prime or pick the top leaves from plants over 7 or 8 feet high, and it would not be advisable for the grower to produce plants which must be topt above that height. The most convenient height for a tobacco shade is about 9 feet. A tent higher than this would be difficult to build, and would be more liable to damage from severe windstorms; hence the necessity for keeping plants below this height by growing more leaves on each plant or by producing plants bearing shorter internodes. The Sumatra and Cuban varieties have a tall habit of growth, with long internodes, but respond readily to methods of breeding in the production of shorter stalks and shorter distances between the leaves.

In all the varieties of tobacco which the writers have improved by seed selection and breeding the internodes are short and the number of leaves proportionally greater in the improved strains. In a careful count of the number of leaves to the plant in a good field of Sumatra tobacco the average was found to be between 19 and 20, while the records made in the breeding plats of strains of tobacco originally grown from the same seed as the general field where these leaves were counted show that the number of leaves was increased by two years' selection to an average of between 23 and 24. The breeding plats and the general field were grown under exactly the same conditions in order to eliminate any influences outside of the results of careful seed selection for the production of a greater number of leaves. The leaves produced on the plants giving an increased number were equal in size and more desirable in shape than those from stalks producing a smaller number.

The increase in yield due to the production of a greater number of leaves on individual plants and to shortening the internodes may be secured by systematic seed selection with no additional cost to the grower. Aside from the increase in yield, the quality of the leaf when there is a large number of leaves borne by the stalks is usually better than when the stalks produce but few leaves. This is particularly true in cigar and high-grade smoking tobaccos. None of the improved types of Sumatra tobacco have leaves sufficiently close together to cause any deterioration in the quality or texture of the leaf during the curing process. In the case of certain types of export and plug tobaccos and in some of the northern-grown cigar-tobacco varieties an increase in number of leaves is not desirable, for the reason that it is conducive to pole-sweat when the crop is being cured. It is further true in the case of these varieties that if the number of leaves is increased without shortening the internode, the plants will become too tall for expeditious handling. Therefore, it is necessary in certain varieties of tobacco to keep the leaves down to a certain definite number, with a desirable length of internode.

It is entirely possible for the grower to control largely the number of leaves by careful seed selection and in this way produce uniformly the plants which give the number desired. Care must always be taken in selecting for a large number of leaves not to increase the number at the expense of leaf uniformity. Only plants having leaves uniform in size and shape should be selected for seed purposes, and this selection must be kept up with unremittent persistency from year to year in order to hold constant the characters of improved strains of tobacco after they have been produced.

A large number of leaves to the plant is almost invariably closely correlated with a much lessened tendency to sucker and with decreased seed production. The plant food in such cases goes to the leaves, where it is most needed, and not into the production of suckers and of seed, which would be a loss to the grower. A large growth of leaf greatly retards the growth of suckers, and in some instances types have been produced which were comparatively suckerless—i. e., types which produced only very few and small suckers. These types are desirable not only from the standpoint of an increased leaf production, but the expense of suckering is in a large measure eliminated.

The habit of growth of the leaves, whether erect, or at right angles to the stalk, or drooping, greatly influences the number of "sand" or ground leaves obtained from the crop. When the leaves are drooping or pendent on the stalk the tips of a number of the lower ones come in contact with the ground and are often covered with sand or beaten and bruised by heavy rains, and are therefore partially or totally damaged. This loss of the lower leaves of the stalk can be very largely overcome by carefully selecting for seed those plants on which the leaves have an upright or erect habit of growth. This very important point in the habit of growth of the plant is often overlookt, but can be easily controlled by systematic selection. In view of the fact that the sand leaves are not nearly so valuable as those which have not been injured in this way, it is highly desirable that this habit of growth of the plant be kept constantly in mind when selecting plants for seed purposes.

The number of leaves on plants of a drooping habit of growth is sometimes greater than where the leaves grow erect or in an upright position, but where a large number of the lower leaves are badly damaged a larger number of the best grade of wrappers may be obtained from plants producing a somewhat smaller number of leaves, but all erect. Individual plants producing a large number of the desirable erect leaves may be found, however, and such plants should be saved for seed under bag in order to propagate the strain the following year.

THE PRODUCTION OF NONSUCKERING TYPES.

The number and size of suckers borne by individual tobacco plants are subject to considerable variation. In making selections of seed plants in many tobacco fields the writers have found plants bearing from 8 to 12 large suckers, and in the same fields other plants producing only one or two small suckers. In Plate V are shown two plants growing side by side in the field, at about the same stage of maturity, one of which bore five large suckers, while the neighboring plant bore only one small sucker. Instances of this kind are common in most tobacco fields. As can be seen in the illustration the nonsuckering plant has a larger number of more rounded leaves than the suckering plant, which condition is usually true in all such cases.

The production of many large suckers is usually correlated with the development of few, heavy, dark, and usually narrow, pointed leaves. This condition is explained on the ground that the large sucker branches take from the plants the elements of plant food which otherwise would be utilized in the development of many broad, round leaves. The possibility of securing nonsuckering types of tobacco was suggested in the course of a series of experiments in the improvement of cigar-wrapper tobaccos. In the selection of seed plants great care was exercised to pick out those bearing the largest number of rounded leaves with fine veins. In the course of the study of the progeny of these plants it was observed that few suckers were produced by the most desirable types of plants. The continued observations on this subject have confirmed the conclusions that there is a correlation between the number, shape, and character of the leaves borne by individual plants and the number and size of suckers produced by these plants.

The number and size of the suckers produced by the plants in all tobaccos is an important practical problem from several standpoints. Owing to the dwarfing and otherwise injurious effect of the suckers it is necessary to remove them by breaking them off, or to "sucker" the plants, as the process is commonly called. There is great danger of breaking, tearing, or injuring the leaves during the suckering process, and this causes much loss in cigar-wrapper varieties, as the injured cigar-wrapper leaf is rendered practically worthless. A careless laborer frequently causes great loss to the grower during the process of suckering the plants. Owing to the fact that the suckers do not develop on all of the plants at the same time and consequently can not all be removed at once, it is necessary to go over the field several times during the season in order to remove all of them.

The cost of suckering is one of the important items of expense in the cultivation of tobacco. Therefore the production of nonsuckering types is an economic problem of great importance, not only by reason of the reduction in the cost of growing the crop, but from the fact that the nonsuckering types usually produce a larger yield of a more desirable quality of tobacco than the suckering types.

It has been found possible to produce uniform strains of different varieties of tobacco having but few and small suckers by saving the seed from nonsuckering plants under bag. As an illustration of the possibility of the growers producing such types the experience of one of the writers in the improvement of the Connecticut Broadleaf tobacco may be cited. In these experiments desirable plants were selected for seed in 1903, producing round leaves of fine, silky texture and few suckers. The crops raised from this seed were found to produce but few suckers, the progeny of the different plants varying somewhat in this respect. From the strains producing the best type of leaves and bearing the least number and smallest size of suckers nonsuckering plants were again selected and the seed saved under bag in 1904. In the season of 1905 it was found that the progeny of these selections were almost free from large suckers. In one strain in particular only a few very small suckers, none of which grew more than 4 inches in length, were produced. The plants raised from ordinary seed of the same variety in the same field produced many large suckers, and as usual it was necessary to sucker the crop several times during the season. The remarkable difference in the suckering and nonsuckering habit has become so well fixt in this particular strain that a limited distribution of the seed was made for testing during the season of 1906.

It has been suggested that by saving seed from sucker branches strains of tobacco are developed which produce an increasingly large proportion of suckers; in other words, that sucker seed tends to produce suckering types of tobacco. In experiments with plants raised from seed saved from the central flower cluster the writers have observed little or no difference. As a rule, however, it has been found that the seed pods in the central flower cluster contain more large and heavy seed than the pods borne by the sucker branches, so that where seed is not carefully separated in order to secure only heavy seed for planting it is probably the best practise to save seed from pods borne by the central flower cluster of the seed head.

THE PRODUCTION OF EARLY VARIETIES.

Early maturing varieties of tobacco are of particular importance to northern tobacco-growing districts. Owing to the fact that frost kills the plants it is necessary for northern farmers to grow varieties which will mature between the time of the last frost in the spring and the first frost in the autumn. After the tobacco crops have been harvested and hung in the barns the curing processes are carried on most favorably during warm weather. The length of time required for the completion of the curing varies with the variety grown, the purpose for which the tobacco is to be used, and the weather. Under normal conditions, however, the natural curing period extends from four to eight weeks. It can readily be seen, therefore, that early-maturing varieties are likely to have more favorable conditions for curing than late varieties, as has proved to be the case in the experience of the tobacco growers in northern districts.

Another fact of importance in this regard is the likelihood of late-maturing varieties being injured in the field by autumnal storms. The earlier the crops can be harvested, the less is the probability of injury by severe rain, wind, or hail storms. In one district of the Connecticut Valley in the season of 1905 a severe hailstorm at about the usual time of harvest completely destroyed all except the early-maturing tobacco, which had been harvested and hung in the curing sheds. This experience is common to other northern tobacco regions and emphasizes the value of early-maturing varieties.

The uniformity in time of maturing of the individual plants in the fields is an important practical matter. In those districts where the tobacco crop is harvested by cutting off the plants near the ground all of the plants in a given section of the field must be cut off at one time. The immature plants can not be left to ripen and the early-maturing plants can not be harvested before the rest of the plants in the field. Overripe or underripe tobacco is likely to be of poor quality. In cigar-wrapper varieties the overripe leaves lack elasticity, gloss, and strength. The underripe leaves are likely to have uneven color and are susceptible to injury by various fungous and bacterial diseases. It is very important, therefore, that the individual plants in the field ripen uniformly, so that they can be harvested at one time without loss or injury.

The lack of uniformity in the maturity of leaves borne at the base, middle, and top of the plants is a cause of loss in value of the crop to the growers. As a rule the bottom or so-called " sand " leaves ripen first, the middle leaves next, and the top leaves last. In the varieties of cigar-wrapper or smoking tobaccos, especially where the entire plant is harvested at one time, the overripe sand leaves and the immature top leaves on such variable plants are inferior in value to the middle leaves. As stated, the color of these sand and top leaves is usually poor and undesirable, and there is also generally a corresponding inferiority in the texture and quality of these leaves. A careful study of the plants in tobacco fields at the time of the harvest has shown that individual plants bearing leaves that ripen uniformly from the bottom to the top of the plants can be found. In the experiments with the production of improved types of Connecticut Sumatra and Connecticut Cuban tobacco it was found that by selecting these uniformly ripening plants and saving the seed under bag uniform strains of these varieties could be produced.

The common practise of harvesting these varieties is to prime or pick off the lower ripe leaves first; then a few days later prime the middle leaves, and finally harvest the top leaves. In the case of the improved strains selected with the object of obtaining uniformly maturing plants practically all of the leaves can be primed at one time. This improvement not only reduces the cost of harvest, but results in a more uniform crop of tobacco.

The differences in rate of growth of the individual plants in tobacco fields, resulting in varying times of ripening of the plants, is illustrated in Plate VI, figure 1. This degree of variability could be found in all the tobacco fields visited by the writers. In Plate VI, figure 2, are shown two rows of plants of the same variety treated exactly alike from the time of sowing the seed to harvest, one grown from the seed of the late and the other from the seed of the early plant shown in Plate VI, figure 1. The difference in time of ripening in this case was seven days; in other words, the early strain was ready for harvest one week before the late strain.

The experiments which have been conducted for the purpose of improving the different varieties of cigar wrapper and filler varieties and of smoking varieties of tobacco have demonstrated that it is possible for tobacco growers to improve the earliness of maturity of their varieties wherever such improvements are desirable. This improvement can be practically carried out by a careful study of the habits of growth of the plants in the field and the selection of the earliest and best plants for seed, saving the seed of these plants with precautions to prevent cross-fertilization. The production of earlier varieties requires several years of systematic selection and must be accompanied by a careful study of the quality and character of the product of the early strains. The practical limitation of earliness or the process of shortening the period of maturity depends on the effect of such change on the quality and yield of the early varieties.

Other things being equal, early-maturing varieties of tobacco are desirable, especially in northern sections, and can be produced by the growers thru the systematic selection of early seed plants. Uniformly maturing plants in a field and uniformly maturing leaves on the same plant are of great importance and can be produced by similar practical methods of seed selection.

THE IMPROVEMENT OF THE BURNING QUALITY.

The nature of the "burn" presents to the grower of cigar, cigarette, or pipe tobacco a most vital question, and, in the case of poor-burning tobaccos, an obstacle which is very difficult to overcome. All previous researches looking toward the solution of this problem have been confined to studies of the conditions of soil, fertility, cultivation, and fermentation, and their relation to the character of the burn of the tobacco, and thru the efforts of those who have carefully investigated these subjects improvements have been made in the burn of most of the varieties of tobacco. A thoro understanding of these phases of this question, however, does not wholly solve the problem, nor does the improvement in methods of culture exhaust the possibilities in the production of uniformly good-burning tobacco. There are no cases on record of previous efforts having been made to improve by breeding and seed selection the combustibility of the varieties of tobacco. Believing it possible to produce better burning varieties in this way, the writers have endeavored in the course of their experiments during the past three years to produce strains of cigar-wrapper varieties which will burn more freely and uniformly than those which are grown at present.

Sufficient progress has been made to show very clearly that the variability in burn of tobacco produced by different plants is not altogether due to favorable or unfavorable conditions of soil, variations in kind or quantity of fertilizers, or to methods of fermentation, but that the individual plants themselves possess some innate character which bears a marked relation to the nature of the burn of the leaves. It is not definitely known whether this is due to the capacity of different plants to take up and assimilate the chemical constituents of plant food in different proportions or whether it is due to the difference in the physiological constitution of the leaves. To the practical tobacco grower it is of little interest to know the exact reason for this variability, but it is of most vital interest to him to know that it does occur, and that the good or poor burning quality of the plant is uniformly transmitted to its progeny, so that the nature of the burn can be largely controlled by seed selection. A difference in the soil or fertilizer, or in the treatment of the crop, always has a greater or less influence on the burn of tobacco, and must be taken into consideration; but in ordinary crops of tobacco, where all conditions are as nearly equal as possible, this marked variation in the burning quality of the individual plants still occurs.

The writers have found plants belonging to the same variety growing side by side under uniform field conditions which showed the widest variation in the nature of the burn. The product of one type of plant would burn freely and evenly, while that of another type had a very poor combustibility. This variation in burn can not be explained on the ground of any difference in soil or cultural treatment, but can only be understood by assuming that there are innate differences in the individual plants in this respect. The writers have proved beyond a doubt that this innate character does exist and is hereditary. Experimental plots of tobacco grown from the seed of the good and poor burning plants have shown that this character is extremely uniform in the progeny, provided other conditions are equal. Plate VII shows two rows of tobacco growing side by side, one of which produced a tobacco that burned very satisfactorily, while the product of the other was very deficient in combustion under ordinary conditions. Taking this variability as a basis, it has been possible to produce by careful seed selection strains of tobacco possessing greatly improved burn without any change in the soil or in the method of handling the soil or the crop.

In the case of one variety of Sumatra tobacco to which the greatest objection was its poor burn, strains have been produced in the course of these experiments which burn in a perfectly satisfactory way without coaling or flaking. Even the top leaves in these particular strains have a free, even burn and good capacity for holding fire.

The production of improved burning strains requires more detailed experimental work than the improvement of shape, size, or number of leaves. No field character of the plant has been closely enough associated or correlated with the nature of the combustion of the cured leaves to make possible the selection of the best burning plants in the field. Consequently they can only be determined by actual burning tests of the tobacco after it has past thru the processes of curing and fermentation. For this reason the leaves of each seed plant must be carefully harvested separately and labeled in a manner to correspond with the label designating the seed saved from the same plant. It is always desirable that each priming of leaves be numbered or marked so that it may be identified after curing and fermentation. This enables the experimenter to make a test of the uniformity of the burn of the top, middle, and bottom leaves of each individual seed plant. There is considerable variability in the degree of uniformity of the burn of leaves borne on different parts of the plant, and therefore it is desirable to secure seed from plants which show a good burn in all the leaves, in order to produce a strain with uniformly good combustion. The leaves of all the seed plants should be cured and fermented under conditions as nearly normal as can be obtained in order to admit of a fair competitive test and to eliminate the possible influence of irregular conditions.

Where large numbers of samples are to be tested specially constructed apparatus is necessary to secure accurate results. A simple form of apparatus has been devised by Dr. W. W. Garner, of this office, for making these comparative tests. It consists of a series of glass tubes so arranged that each tube will smoke a cigar in very much the same manner as it is smoked by an individual, but with more regularity and uniformity. This apparatus is operated by means of an intermittent flow of water which subjects all the cigars to exactly uniform conditions. A carefully adjusted aspirator draws the proper intermittent current of air thru the cigars, and is so connected with the tubes that exactly the same strength of current is drawn thru each cigar. A paper has been prepared by Doctor Garner[a] which describes this apparatus and method of laboratory tests of the burn of tobacco in detail. By smoking several cigars at the same time by the use of this device it is possible to make very close and accurate observations on the rate and evenness of burn, color of ash, and other characteristics of the tobacco from different plants.

Cigars are prepared for this test from all the samples to be tested from the different plants and are allowed to dry out under natural but uniform conditions. The method employed by the writers in determining the comparative combustibility of the leaves from each seed plant is as follows:

One cigar is made wholly from the leaves of each plant, using the top leaves for filler, those next to the top for binder, and one side of a middle leaf for the wrapper. The other half of the wrapper leaf is reserved for a supplementary test, which will be described later. The object in making the entire cigar from the same plant, whether it is a filler or a wrapper type, is to eliminate the possible influence of any other tobacco upon that which is being tested. After the cigars have dried sufficiently, they are placed in the apparatus for smoking and all drafts excluded from the room to secure absolute uniformity of conditions. While the cigars are burning they are scored on the several points which go to make up a good or poor burn. The differences in character of burn of tobacco from the different plants when smoked under these uniform conditions is very surprizing, and shows clearly the variability of the quality of burn in tobacco produced by different plants grown under uniform conditions.

The rate of burn is carefully determined, and the degree of uniformity or evenness noted. Some cigars will burn down on one side and go entirely out on the other, while others burn completely and evenly. Some will burn much more rapidly than others and with greater evenness. In many cases the wrapper puckers or swells just ahead of the fire, and often a shiny, metallic, black ring will appear just back of the burning tobacco. Sometimes both of these phenomena are present, and in this case the black ring, which indicates what is known as a metallic burn, appears between the fire on the cigar and the ring caused by the puckering or swelling of the leaf. These rings indicate a poor burn and are invariably associated with poor-burning tobacco and very frequently with an undesirable or bitter taste.

The comparative degree of coaling, i. e., a swelling of the wrapper at the burning point leaving a black ash, can be readily determined and noted in these tests. The character of the ash is also considered very important, and in case it flakes badly or is of a very dark, dull color the seed from plants producing such tobacco is discarded. The seed from only those plants which produce tobacco that burns evenly, closely, and holds fire well, with no coaling and with a white, close, compact ash, is selected for further planting in the production of good burning types.

---

[a] Bulletin No. 100, Part IV, Bureau of Plant Industry, U. S. Department of Agriculture.

In the case of cigar-wrapper tobacco an additional test is made in which some standard filler and binder tobaccos are used and only the wrappers are taken from the plants to be tested. This gives an opportunity to observe the effects of other tobaccos on the burn of the wrapper and gives a test which may be compared to the testing of the wrapper in the ordinary way on cigars. A good, uniform grade of filler and binder is used in these tests. The wrappers from the best burning plants burn a little ahead of the filler, but hold fire well and burn evenly around the cigar.

These tests are further supplemented by another and more delicate one for bringing out the fine points of difference in the wrapper leaves from the individual seed plants without the possible influence of any other filler or binder, or of poor workmanship. Wrappers taken from the half leaf left in making the cigar test are placed on prepared forms, the shape and size of an average cigar, just as they would be placed on a cigar, and are allowed to dry on these forms. The forms are removed after the wrappers are thoroly dried, leaving the wrapper in the shape of a tube, just as it would be if it could be removed from the cigar in a dry condition. One end of this wrapper tube is placed over the end of a glass tube, upon which it fits closely. A current of air is then drawn thru the glass tube, entering at the end on which the wrapper was placed and of sufficient strength to give the best conditions for burning. The end of the wrapper is then lighted with a spreading flame, and accurate notes are taken on the length of time the tobacco holds fire and the character of the burn. The wrappers from the best burning leaves will burn up evenly, but where the combustion is at all deficient it is clearly brought out in this test. In many cases instead of burning evenly the fire will run in streaks about the leaf or will go out when it reaches a vein. Some of the leaves will scarcely burn at all under these conditions, while others will burn in a very satisfactory way. This final, delicate test is used more especially for cigar wrappers than for any other class of tobacco. In all cases a final test is made by smoking a cigar made from the tobacco under test.

Whether the grower uses the methods which we have described in testing the burn of his tobacco or not, it is comparatively easy for him to make a definite test of the combustibility of the leaves from all the plants which he selects for seed, and in this way gradually breed up good burning types of tobacco in which the burn will be uniform thruout. This uniformity in type can only be secured by saving the seed of the plants producing the good-burning type of tobacco, these having been protected from cross-pollination according to the method described in this bulletin.

THE SELECTION OF SEED PLANTS.

The successful improvement of tobacco varieties by selection depends on the characters of the plants saved for seed production. Too much emphasis can not be given to the necessity for great care in the selection of seed plants. The history of the production of the valuable varieties of tobacco by seed selection is sufficient evidence of the importance of this subject. The running out or deterioration of the established varieties where careful seed selection has not been followed and the consequent deplorable financial condition of the growers of these inferior tobaccos is additional argument for the adoption of the most improved methods of saving seed by all growers. Inasmuch as any improvement in the yield or quality of tobacco means that much additional profit to the growers and manufacturers, attention to seed selection is a matter of direct financial importance as well as scientific interest.

The development of highly specialized means for manufacture and the increasing demand by the consumers for a variety of manufactured tobacco products are important reasons for the most careful study of seed selection as a means for producing tobacco adapted for the manufacture of special grades. In fact, a survey of the conditions of the tobacco growers in different sections shows that in those regions where a systematic attempt is made to produce a type of tobacco adapted to the specialized market requirements the prosperity of the tobacco growers is much greater than where no such attention is given to the improvement of the crop. It can be safely stated that the tobacco grower of the present day and of the future must either keep pace with the demands of the market or be forced out of business. Owing to the increased general prosperity and wealth of the United States, tobacco consumers are constantly demanding a higher grade of tobacco, a demand which, if taken advantage of by the producer, means greater profit and better prices for the specialized crops.

The common practise in selecting tobacco seed plants in many tobacco-growing regions is to save a group of a dozen plants, more or less, depending on the acreage of tobacco grown, in some convenient corner or section of the field where they will interfere least with the harvesting of the crop. A visit to any tobacco-growing region in the United States shortly after the crop is harvested will show these clumps of plants which have been left for seed. It is usually the practise of the best growers to save portions of one or more rows producing the best plants, but frequently even this care is not given to this most important factor of tobacco growing. On the large tobacco plantations the writers have frequently observed a section of the field set apart for seed production. In some cases the poorest plants in such sections have been topt, while in others this practise has not been followed. This method of selecting seed plants is not as desirable as that employed in saving seed in most farm crops. It means that the growers do not take advantage of the variability of the individual tobacco plants in the field, and consequently lose the benefits to be derived from using the best plants as the parents for the next year's crop. After carefully studying the plants in hundreds of tobacco fields, the writers have found that the best plants do not grow in groups, but in different parts of the field, and can only be found by diligent search and careful observation of the crop, plant by plant, from the time the plants are set out in the field until they are topt. As soon as the benefits to be derived from seed selection and breeding have been demonstrated in tobacco-growing communities the growers are usually quick to take advantage of the improved methods of saving seed.

It has been frequently urged that change of seed is beneficial. In the light of recent investigations and observations on this subject this contention is believed to be incorrect in the case of tobacco. In other words, seed should be saved on the farm or field where the crop is to be grown. A change of seed is always experimental, and, as pointed out in the discussion of the introduction and acclimatization of new varieties, such change when necessary should be made only after carefully testing the seed for several years and securing by selection a strain which is adapted to the local soil and climatic conditions. In some tobacco-growing sections growers frequently buy their seed or obtain it from some other source than their own crop. While it may be true that this practise may be advisable in some cases—for example, when the seed is procured from tobacco-seed breeders having the same general soil and climatic conditions as the growers—this plan is not a good one to follow as a regular source of seed and is not practised by the most successful tobacco growers. The experience of the best growers and of scientific investigators of tobacco, as in the case of other farm crops, such as corn and cotton, goes to prove that the best policy is for every grower to save his own seed from the best plants in his crop. Instead of the varieties of tobacco running out by reason of having been grown under the same conditions continuously, it has been demonstrated that they are improved by the adoption of simple and practical methods for the selection of seed plants and the saving of seed.

In order that the grower or breeder may select seed plants intelligently it is necessary for him to form an ideal of the type of plant which it is desirable to grow. Without a clear conception of the type of plant desired any improvement by seed selection will be accidental, and as a rule the efforts in this direction will be unsuccessful. It is also necessary in forming the ideal to keep in mind the purpose for which the tobacco is produced in order to develop a type which will meet the demands of the market. For instance, in the growing of cigar-wrapper tobaccos a broad, round leaf, adapted for the cutting of the largest possible percentage of wrappers, is most desirable, so far as the shape of the leaf is concerned. The production of a high-yielding type must be governed in all cases by the effect of such change in the size and number of leaves upon the quality of the tobacco. The information necessary for the intelligent selection of desirable plants for seed can only be gained by a careful study of the plants, the cured and fermented product, and the market demands.

The plan of selection of seed plants followed by the writers is to examine with greater or less care, several days before topping, every plant in the field from which selections are to be made. As indicated before, it is always advisable to study the plants from the time they are set out, whenever this plan is practicable, with a view to picking out the best plants for seed. Such plants, when found, can be marked with a tag, string, or heavy rag, so that they can be readily identified when the final selection is made. Some characters, such as time of maturity, are more easily observed in the young plants than later; hence the importance of marking the plants showing the characters desired whenever they are found.

The size of at least three leaves in apparently desirable plants should be measured—one at the bottom, one near the middle, and another at the top of the plants. These measurements can easily be made with an ordinary yardstick, taking the length from the point of attachment of the leaf to the stalk to the tip and the width at the broadest point. The development of the top leaves by reason of further growth can be taken into consideration, tho in most tobaccos well-developed top leaves are correlated with early-maturing plants and always with uniformity of leaves on the same plant. The shape, size of veins, color, texture, and other characters of the leaves should be taken into consideration.

The number of leaves should be counted, also the number of suckers, and observations made, and, if possible, recorded of the uniformity of the shape, size, and other characters of the leaves in different portions of the plants, the presence of rust or other fungous or bacterial diseases, the height of the plants, and the space between the leaves, or length of internodes. The transmission of these characters from parent plants to progeny is shown in Plate VIII. A detailed estimate of the plants in the field in respect to these characters is valuable only as a guide to the selection of the best type of plants for a particular or a pedigree record, but must always be of secondary importance to the judgment of the grower as regards the general type of the plants and their adaptability for successful and profitable production.

In cigar-filler, smoking, and other varieties an intelligent selection can only be made by the study of the cured and fermented leaves. In this case it is necessary to save of plants that show in the field the general physical characteristics desired several times the number that will be necessary for seed. The leaves of these plants must be primed and kept separate, properly labeled, hung in the curing shed with the remainder of the crop so as to get normal curing conditions, and carried thru the processes of fermentation with the bulk of the crop. After the fermentation or sweating process has been completed, the samples from the individual plants can be tested, the seed from the poor plants discarded, and the seed from the best plants saved for planting. A description of the apparatus which has been devised in the Office of Plant Breeding Investigations for testing the burn or combustibility of cigar wrappers and for assisting in the comparison of the quality of cigar-filler and smoking tobaccos has been published, as previously stated. In the study of the samples from the individual seed plants it is absolutely necessary that they all be brought under uniform conditions of moisture, heat, and other conditions affecting the character of the leaves before the tests are made. Final tests must always be confirmed by the use of the tobacco in cigars, pipes, or by other means of consumption for which the tobacco is adapted.

RECORDS OF BREEDING WORK MADE IN THE FIELD.

The form of record blank used in the breeding work of the writers, together with the directions for note taking and definition of terms, is given here for the benefit of those who may wish to carry on systematic breeding work and keep a pedigree record of the parent plants and their progeny. This plan of record keeping is being constantly revised as the knowledge on the subject increases, but up to the present time the plan described has been found to be very useful and valuable, covering the most important characters and points necessary for an adequate record. The plants finally selected for seed are usually given a number for identification, this number being written on a small, strong tag attached to the top of the plant below the paper bag with a short piece of flexible wire.

The following form for note taking in the field is printed on a large shipping tag:

Tobacco } No.________________
U. S. P. B. }
Date ____
Type ____
Leaves:
    Number ______________________ Length ______________________
    Width ______________________ Thickness ______________________
    Shape ______________________ Color ______________________
    Uniformity ______________________ Rust ______________________
    Spots ______________________ Gum ______________________
    Maturity ______________________ Position ______________________
    Venation ____
Stem:
    Height ______________________ Circumference ______________________
    Length of internodes ____
Suckers:
    Number ______________________ Size ______________________
    Position ____
Seed:
    Number of pods ____
    Date of picking ____
Harvest:
1st 2d 3d

The directions for note taking for use in making field notes adopted by the Office of Plant Breeding Investigations of the United States Department of Agriculture are as follows:

In order to secure uniformity in nomenclature and note taking and promote uniform methods of classification in the tobacco-breeding experiments the following system has been adopted and should be closely adhered to by those conducting these experiments and applied to all records made in the course of these investigations:

NOMENCLATURE.—The word *variety* should be used to designate distinct, well-recognized, and established kinds of tobacco; as, for example, Sumatra, Connecticut Havana, White Burley, and Zimmer Spanish.

The word *strain* should be used to designate a slight local modification of a variety in which some intrinsic quality has been bred, such as tendency to produce a heavier yield, improved shape of leaf, or better adaptability to local conditions, as, for example, Cooley's Connecticut Havana, Connecticut Sumatra, or Jones's Zimmer Spanish.

The word *type* should be applied to new varieties which are selected for experimental purposes and have not come into commercial use.

TYPE NUMBERS.—In the fields where selections are made several distinct types may be found, and a number of seed plants should be selected for experimental purposes in each type. A number should also be given each type, and in all records of experiments with this type it should be referred to under this number. When a new type is found the list of existing type numbers should be consulted, so that no two types may be given the same number. For example: *Variety*, Sumatra; *strain*, Connecticut Sumatra; *type*, *1* (Crumple). Wherever it may be desirable the type may be further identified by a distinctive name, as for example, in the case of the Connecticut Sumatra strain, *type, 2* (Green leaf); *type, 4* (Broad leaf).

Selection numbers.—The individual plants selected for propagation should be given numbers which will serve to identify them, as well as the type and the generation to which they belong. Each plant is represented by a combination of numbers, the first one representing the series and usually corresponding to the type in which the plant belongs. Each succeeding number represents the individual parent plants in that generation, the last being the number of the individual selection in the last generation. For example, in the experiments with the improvement of Connecticut Sumatra tobacco in the second generation of selections the following numbers have been used: 1–5–6. The first number (1) refers to the series, and, in this case, to type 1 in the Connecticut Sumatra strain; the second number (5) refers to the number of the seed plant selected and used for planting the second generation; the last number (6) refers to the seed plant saved for planting the third generation selected from the crop raised from plant No. 1–5; while 2–3–8 refer to a selection of the green leaf Connecticut Sumatra type, plant No. 3 of the first generation, and plant No. 8 of the second generation selected from crop raised from No. 2–3.

Hybrid numbers.—The general plan of assigning numbers to tobacco hybrids is similar to the system followed in the selections except in the case of the type number, which consists of a figure and a letter. The letter is added to the figure in order to distinguish the hybrids from the selections and may be used to identify the individual hybrids of similar parentage. A different type number should be given to each series of hybrids, and a different letter to each hybrid within the series, as, for example, 41a, 41b, and 41c refer to individual hybrids between Connecticut Havana and Connecticut Sumatra; 42a to hybrids between Connecticut Havana and Connecticut Cuban, and 43a to hybrids between Connecticut Broadleaf and Connecticut Cuban, respectively. The hybrid numbers should not be duplicates of the selection numbers.

Assignment of numbers.—In order to prevent confusion arising from using the same numbers in different sections, it is proposed to assign certain numbers to each natural center of breeding experiments. These numbers should be consulted before new numbers are given to types or hybrids. The numbers from 1 to 100, inclusive, are assigned to the Connecticut Valley experiments; 101 to 200, inclusive, to the Florida experiments, and 201 to 300, inclusive, to the Maryland experiments.

The names of the established varieties of cigar-wrapper tobaccos grown in the Connecticut Valley are (1) Connecticut Havana; (2) Connecticut Broadleaf; and the varieties introduced in an experimental way which are grown to a limited extent under cloth shade are (1) Sumatra and (2) Cuban. A number of distinct strains of Sumatra and Cuban varieties grown from imported seed have been produced and are recognized as modified types of the Sumatra and Cuban tobaccos, so that in order to distinguish these types from the imported varieties they should be known as Connecticut Sumatra and Connecticut Cuban tobaccos. The types which have been selected for experimental purposes are as follows: Connecticut Sumatra type: 1, Crumple; 2, Greenleaf; 3, Sumatra; 4, Broadleaf; 5, Belgian; 6, Abnormal; 7, Smoothleaf; 8, Freak; 9, Mosaic; 10, Mongrel; 25, Holcomb Hollow; 27, Resistant; 28, Diseased. Connecticut Cuban type: 11, Cuban; 12, Dark Green; 13, Havana; 14, Freak. Cuban: 20, Imported Cuban. Connecticut Havana: 36, Cooley. Connecticut Broadleaf: 50, Brewer; 55, Favorite.

The principal variety of tobacco grown in Florida for cigar-wrapper purposes has been developed from imported Sumatra seed and is commonly known as Florida Sumatra tobacco. The Florida Sumatra types which have been selected for experimental purposes are: 101, Lott; 102, Attapulgus; 103, Ovalleaf; 104, Greenleaf; 105, Shortstem; 106, Prolific; 107, Spiralbud; 108, Corry; 109, Fain; 110, Bell; 111, Gregory.

The variety of tobacco grown in Maryland for smoking purposes is commonly known as Maryland Smoking. The types which have been selected for experimental purposes in this variety are: 201, Sasser; 202, Satin; 203, Thickset; 204, Narrowleaf; 205, Red Clay; 206, Hill; 207, Holland; 208, Drury; 209, Long Red; 210, Wilson.

MEASUREMENTS OF STEMS.—The height of the stem of seed plants should be measured from the surface of the ground near the base of the plant to the last 12-inch leaf at the top which would be left after topping. The height of stem-topt plants should be measured to the leaf that will be highest after topping. so that in all cases the length of internodes may be determined by dividing the height of the stem by the number of leaves borne by that plant. The measurements should be made at the time of the first priming or just before cutting.

The circumference of the stem should be measured half way between the point of attachment of the middle leaf and the one next below, just before harvest.

MEASUREMENTS OF LEAVES.—The third leaf from the bottom (1), the middle leaf (2), and the third leaf (3) from the top should be used for determining the size of leaves. The length should be measured from the point of attachment to the tip of the leaf. The width should be measured at about the middle of the leaf at its widest point.

The number of leaves counted for record should include all except those top leaves under 12 inches in length which would be cut off in topping.

DESCRIPTIONS OF LEAVES.—Definitions of the terms used in the description of leaves are given below:

Shape:

- *Linear.* Narrow; several times longer than broad.
- *Lanceolate.* Tapering; several times longer than wide.
- *Oblong.* Nearly twice as long as broad.
- *Elliptical.* Oblong, with flowing lines.
- *Oval.* Broadly elliptical.
- *Ovate.* Like section of a hen's egg.
- *Cordate.* Heart-shaped.
- *Obovate.* Larger at tip than at base.

Uniformity:

- *Very good.* All leaves alike from top to bottom of plant.
- *Good.* The midddle leaves alike.
- *Medium.* Irregularity not marked.
- *Poor.* Irregularity marked.
- *Very poor.* Very undesirable irregularity.

Position:

- *Erect.* Makes sharp angles with stem.
- *Partly erect.* Between erect and horizontal.
- *Horizontal.* At right angles with stem.
- *Drooping.* Tops of leaves drooping.
- *Pendent.* Hanging downward.

Venation:

Coarse. Large midrib and veins; veins spreading over entire leaf into margins.
Medium. Large veins in central portion of leaf.
Fine. Small midrib and veins; veins not prominent in the margin of the leaf.

Rust:

None. Absence of rust.
Slight. A few spots on few leaves.
Injured. Parts of the leaves destroyed.
Destroyed. Most of the leaves rusted.

Leaf spots:

None. No spots present.
Incomplete. Part of the leaves evenly spotted.
Complete. All of the leaves evenly spotted.
Irregular. Part of the leaves irregularly spotted.

Amount of gum:

Slight. Very little gum present.
Medium. Deficient.
Normal. The desirable quantity.
Excessive. More than desirable.

Maturity:

Very early. About two weeks earlier than medium.
Early. About one week earlier than medium.
Medium. Usual time of maturity.
Late. About one week later than medium.
Very late. About two weeks later than medium.

Thickness:

Thick. Very coarse and heavy.
Medium. Usual thickness.
Thin. Light and thin.
Very thin. Very thin texture.

Color in field:

Very light. Pale yellowish green.
Light. Pale green.
Medium. Green.
Deep. Concentrated green.
Dark. Dark green.
Very dark. Very dark green.
Yellow. Yellow green.
Very yellow. Deep yellow green.

Color in warehouse:

Very light. Very light brown.
Light. Light brown.
Medium. Most desirable brown.
Dark. Dark brown.
Very dark. Very dark brown.

Elasticity:

Strong. Leaf stretches without tearing.
Medium. Between strong and weak.
Weak. Does not stretch and tears easily.

Date of germination, etc.—In making notes on the date of germination and date of coming up the following outline may be used:

Date of germination:
  - *Very early.* Most vigorous and early.
  - *Early.* Vigorous and large percentage sprouted.
  - *Medium.* Medium early.
  - *Late.* Few sprouted.
  - *Very late.* Very few sprouted.

Date of coming up:
  - *Very late.*
  - *Late.*
  - *Early.*
  - *Very early.*

Date when cured, etc.—The date in column headed *Cured* (in the record form for field notes) is the time of taking down the leaves in the sheds. The date in column headed *Bulked* is the time the tobacco is put in bulk and fermendation begun. The date in the column headed *Fermented* indicates the time that the tobacco has finished fermentation in bulk and is ready for sizing and assorting. *Yield* is the weight of each grade as assorted for trade conditions.

PERMANENT RECORDS OF BREEDING WORK.

A convenient way for making a permanent record of the individual notes on the parent plants and their progeny is shown in the following form, which is printed for the Office of Plant Breeding Investigations on sheets kept in a "loose ledger" cover adapted for this purpose:

96

Tobacco selection.

Individual sheet.

Tobacco Selection No. ....

Parent variety .... U. S. P. B. No. ....

Locality .... Field .... Type .... Date .... Experimenter ....

P. B. Form 25.

Individual notes:

SEED.						LEAVES.														
Date sown.	Date of germination.	Date sown in seed bed.	Date of coming up.	Uniformity of young plants.	Date transplanted.	Number.	Length.	Width.	Thickness.	Shape.	Uniformity.	Position.	Rust.	Spots.	Amt. of gum.	Maturity.	Color. F.	Color. W.	Elasticity.	Venation.
							1													
							2													
							3													

STEM.			SUCKERS.		Type.	Seed pickings.			HARVEST.			Cured.	Bulked	Fermented.		YIELD.			Total score.
Height.	Circumference.	Length of internode.	Number.	Size.					1	2	3					1	2	3	
																4	5	6	
																7	8	9	
																10	11	12	

Progeny notes:

SEED.							LEAVES.														
Date sown.	Date of germination.	Per cent of germination.	Date sown in seed bed.	Date of coming up.	Uniformity of young plants.	Date transplanted.	Number.	Length.	Width.	Thickness.	Venation.	Shape.	Uniformity.	Position.	Rust.	Spots.	Amt. of gum.	Maturity.	Color. F.	Color. W.	Elasticity.
								1	1												
								2	2												
								3	3												

STEMS.			SUCKERS.							Maturity.	HARVEST.			Cured.	Bulked.	Fermented.	YIELD.			Total score.
Height.	Circumference.	Length of internode.	Number.	Size.							1	2	3				1	2	3	
																	4	5	6	
																	7	8	9	
																	10	11	12	

In the breeding work conducted by the writers a portion of the seed from the plants saved for seed is sown in small sections in the seed beds and the plants are subsequently transplanted to separate rows in the field. From the rows of plants producing the best type and quality of tobacco further selections of seed plants are made. In this way the productive capacity of the individual seed plants can be tested and a record of their performance made by the breeder. Usually 100 plants are grown from the seed of each seed plant in the individual rows in the test plats.

The sections of the seed beds necessary for producing this number of plants at one time for transplanting are usually 3 by 3 feet in size, boards one-half inch in thickness and 6 inches in width being used for making the partitions. These boards are usually sunk in the beds about 2 inches to prevent mixture of seed between the different sections. Necessarily the quantity of seed required to sow these sections is very small, about 1 gram being used for this purpose, which should be taken from the general seed product of the individual plant. The seedlings from these sections can be transplanted by hand, care being taken not to injure the roots, and sufficient water supplied to start the plants under favorable conditions. This plan of testing the individual seed plants may not be practicable for the grower of a small crop, but can be used to advantage by tobacco breeders.

After the seed plants have been selected in the field the flowers should be protected from cross-fertilization and the seed saved in accordance with the directions given under the head of methods of saving seed.

METHODS OF SAVING SEED.

The absolute necessity of saving seed free from cross-fertilization was recognized by the writers in the beginning of the tobacco-breeding experiments. The readiness with which tobacco flowers are cross-pollinated has been shown in a previous section, giving a description of the flower, and has been emphasized all thru this bulletin. The securing of pure, unmixt seed is necessarily of the first importance in developing improved strains of tobacco which are sufficiently uniform to meet the requirements of the manufacturers. After trying various methods of keeping the seed pure by covering the flower head of the plant it was found that the most practicable and efficient way to protect the flowers from cross-pollination was by the use of a light, strong manila paper bag, which serves to keep out all agents whereby pollen may be transferred from plant to plant and from flower to flower, and at the same time does not interfere with the proper development of the flower head and the seed. This method impresses all growers at first as being impracticable, but it has been found by the writers and by many growers who have adopted it to be thoroly practicable and in every way effective. Nearly all the growers in the Connecticut Valley, where the work was first begun, are saving their seed in accordance with this method, which is sufficient evidence of its adaptability to practical farming conditions. The form of bag used must not be thick or heavy enough to affect the natural transpiration and growth of the plants. The kind which has been adopted for general use is the lightest grade of manila bag that can be procured at the grocery or country stores. There is greater liability of the seed being injured under southern or tropical conditions by using a bag which is too heavy than there is in the North. In order to prevent any possibility of injury from this cause, the writers have adopted the method of puncturing the bag with a large number of very fine holes, which will admit air and at the same time are not large enough to allow insects to pass through and carry the pollen from plant to plant.

The bags may be punctured by using a sewing machine and arranging the bags as in sewing ordinary cloth. The sewing-machine needle of course must not be threaded for this purpose. For the average tobacco plant the paper bag of 12-pound size has been found to be the most satisfactory. When the plants to be bagged are of a small variety, the 10-pound bag may be large enough, but it will not allow sufficient room for the proper development of the seed head on a tobacco plant of average size.

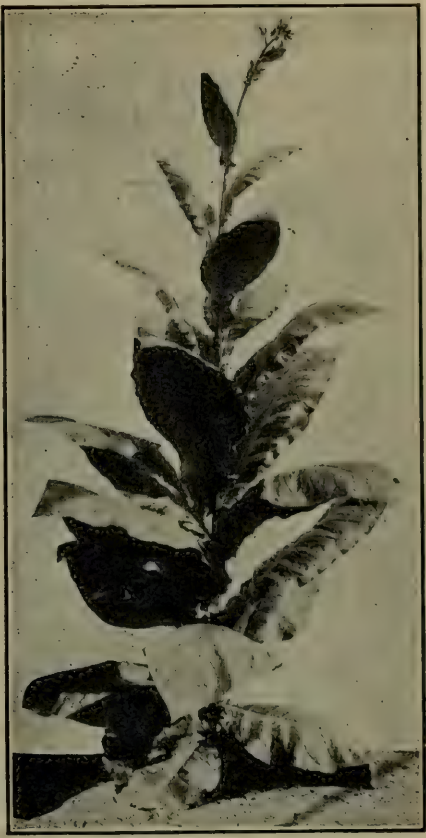


FIG. 6.—Tobacco seed plant at proper stage of maturity for the application of a paper bag. The bag should be placed over the seed head just before the first flowers open. The top leaves and sucker branches should be removed before arranging the bag, in order that nothing may interfere with the development of the seed head.

The proper time for bagging is just before the first flowers open and are ready for pollination. At this time the stem of the flower head is sufficiently strong to support the weight of an ordinary paper bag without injuring the plant in any way. When the bags are applied earlier than this, the operation is more difficult and the tender top of the plant is liable to be broken off or bent by the weight of the bag. When the growing plant has reached the proper stage for bagging, all branches just below those which form the main flower head and all small leaves should be carefully removed. The accompanying illustration, figure 6, shows the earliest flowers just ready to open, which indicates the right stage of development for bagging. After the flower head has been carefully prepared, as indicated, the bag should be inverted, placed over the flower head, the mouth gathered closely around the stem just below the flower branches and tied loosely enough to allow sufficient room for further growth, as shown in figure 7. At this stage of the plant's development the flowers bloom rapidly, and a corresponding rapidity of growth takes place in the flower head. This condition makes it necessary to visit the bagged plants in the course of five or six days in order to take the bags off and remove all superfluous growth in the nature of small leaves, so as to give as much room as possible for the development of the flowers. The bag must be replaced immediately, before insects have an opportunity to visit the flowers and transfer pollen. This process should be repeated two or three times during the season and the bag elevated each time in order to allow for the rapid growth of the stem.

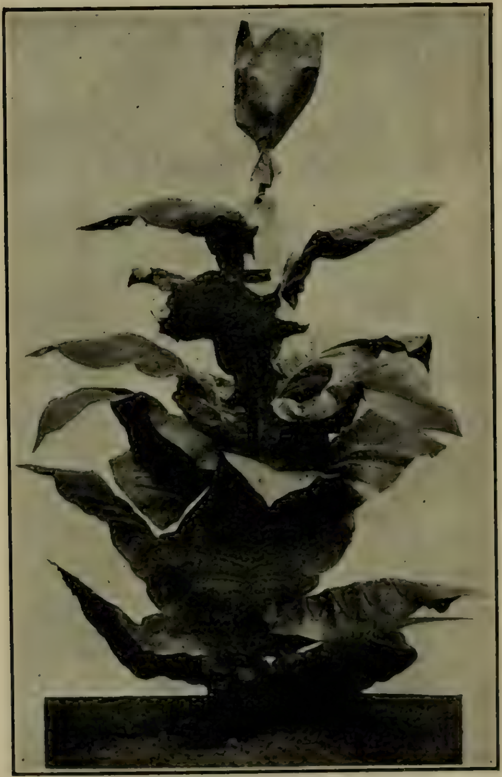


FIG. 7.—Tobacco seed plant showing arrangement of a paper bag for the protection of the flowers from cross-fertilization. At this stage of development a tobacco plant increases in length very rapidly; consequently, the bag should be tied loosely so that it can be easily pushed up the stalk.

After a sufficient number of pods have set seed to produce the normal quantity of seed, the bag may be removed to prevent any possibility of mold during continued periods of rainy weather. When this is done all late buds and flowers must be broken off, leaving only the pods which have been fertilized to produce seed. It is also desirable to remove all seed pods which are poorly developed, in order to eliminate some of the seed which is likely to be light and undesirable.

When all the pods are mature the plants are cut in the ordinary way and hung to dry in a barn or other place having a free circulation of air. In order to catch the seed of pods which open during the process of drying, it is customary to put new bags over the seed heads at the time the plants are cut. Thoroly dry seed may be shelled and stored in glass vials or bottles with perfect safety, and can be kept almost indefinitely in this way. The fully matured and dry tobacco seed will retain its vitality when kept dry for ten years, or, as has been observed in several cases, a much longer time.

The seeds saved in accordance with the methods here outlined are larger, heavier, and of higher vitality than those saved in the ordinary way. Self-fertilized seeds are free from the introduction of hereditary tendencies from surrounding plants, and the characters of a single plant are transmitted to the progeny with almost as great uniformity as in the case of vegetative reproduction or propagation from cuttings.

This method of saving seed requires very little more time than the old method, and at the same time gives the grower an opportunity to study the types of tobacco in the field by coming in closer contact with the seed plants themselves. He will of necessity make closer observations as to the points of perfection or imperfection in individual plants, and by protecting the flowers from cross-pollination it is entirely possible for him to produce a pure and uniform strain of tobacco after selection for two or three years, to improve his tobacco in every way, and to weed out the undesirable and unprofitable types which occur so frequently in the general tobacco field.

SEED SEPARATION.

The special value of large, heavy seed in the production of general farm crops has long been established. Careful farmers and seed growers have used various methods for selecting this grade of seed for planting. Experiments with light and heavy seed in this and other countries have demonstrated clearly and conclusively that larger yields are obtained from heavy, plump grains than from small, light seed. Live-stock breeders do not breed from weak or poorly developed parents, and it is just as important that plants be bred from heavy seed with strong parentage as to use the best animals in the production of improved breeds of live stock.

The writers have found this principle to be strikingly emphasized in the production of tobacco from different grades of seed. The plants from large, heavy seed not only grow more vigorously, but have greater resistance to certain bacterial and fungous diseases and show greater uniformity in the field and warehouse than plants produced from inferior seed. Thus it can be seen that the specific gravity of individual seeds has a very important bearing on some of the main factors in the production of profitable crops of tobacco. The reason for this is very evident when we consider the fact that the heavy seeds contain a larger supply of food for the development of young plants than the light seeds. It is not always true that the heavy seeds germinate first, or that the plantlets from such seeds make the most rapid growth in early stages of development, but they always make a healthier, more strudy, and stronger growth, and produce much better plants in the end. The comparative size, production, earliness, and other characters of plants raised from light and heavy seed are shown in Plate IX, figure 1. It frequently happens that the light seed are the first to germinate, and in some cases the young plants from the light seed are first to reach the proper stage for transplanting. However, after they are about half grown they show freaky tendencies and are very susceptible to various diseases, are unstable, and of little value to the tobacco grower. They sometimes bloom earlier and mature before the average well-developed tobacco plants in the field, but are deficient in yield and other important qualities. Such plants are, of course, undesirable from every standpoint and should be eliminated before being transplanted to the field, so as to give place to vigorous plants grown from heavy seed.

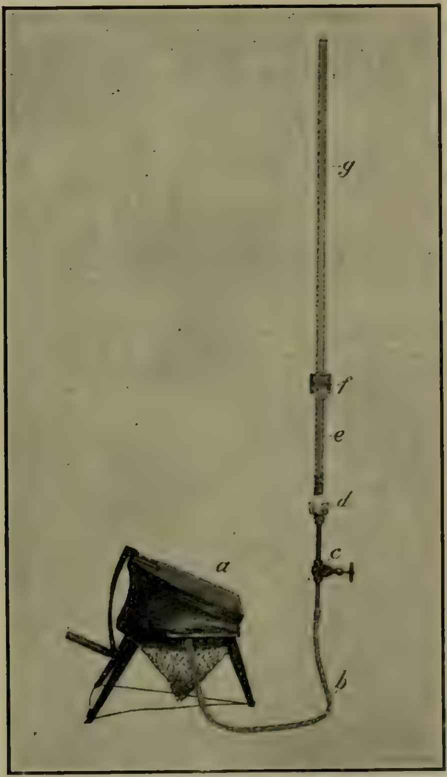


FIG. 8.—Tobacco seed separator. This apparatus separates the light, immature, and poor seed from the heavy seed, and can be so regulated as to furnish any degree of fineness of separation desired. It is now being used extensively by tobacco growers.

It is almost impossible to select and discard in the seed bed the weak plants produced from light seed, so that it must be done, if at all, before the seed is sown. Doctor Trabut, in his experiments with tobacco, sought to make a separation of tobacco seed according to different degrees of specific gravity by throwing the seed upon water and discarding those that continued to float after a certain length of time. This process effects a partial separation, but it is incomplete. The extremely small size of tobacco seed makes this method rather impracticable, for the reason that minute air bubbles will adhere to the seed for a considerable time and hold many of the heavy seed on the surface, while some of the lighter ones will lose the air bubbles first and sink to the bottom with the heavy seed. Notwithstanding the incompleteness of this method, Doctor Trabut found a great difference in the growth and productiveness of the seed which sank to the bottom of the vessel first, and he brought to light new and vital facts regarding the importance of using heavy seed.

In order to secure a more complete separation of the light from the heavy grade of seed, the writers have devised a simple and practical wind-blast apparatus, shown in figure 8, for separating tobacco seed into heavy and light grades. This apparatus has already come into general use by tobacco growers in the United States and other countries. It was described by Mr. A. D. Shamel in the Yearbook of the Department of Agriculture for 1904. The seed separator here illustrated is a slight improvement over the original apparatus as described by Mr. Shamel.

The improved apparatus consists of a foot bellows (*a*), connected with a globe valve (*c*) by means of a rubber tube (*b*). The valve (*c*) is connected directly with the seed receptacle (*e*). The seed receptacle consists of a 1-inch glass tube (*e*) about 14 inches in length, cemented in the reducer (*d*) with plater of Paris. At the extreme bottom of the glass tube *e* and just above the top of the valve (*c*) a fine wire gauze is fastened. The object of this gauze is to prevent the seed from falling into the valve from the receptacle, and therefore it is necessary to use a wire gauze with very small mesh. An ordinary gas pipe coupling (*f*), about 3 inches in length and slightly larger than the tube *e*, is firmly cemented to the top of the tube to serve as a support for the tube *g*. The tube *g* is of glass the size of tube *e* and about 6 feet in length. The apparatus can be supported by a convenient frame, which may be fastened to the wall or set up wherever desired.

The bellows and tubing for this apparatus may be procured from any chemical supply house, and the remaining parts from hardware stores. They can be easily put together and the apparatus set up in the proper manner by anyone who wishes to use it. A complete device of this nature should not cost more than $5, a very small sum compared with the benefits to be derived from getting rid of the light and undesirable seed. In the successful operation of this apparatus the following method should be employed: Pour about 1 ounce of the tobacco seed to be separated into the seed receptacle, and by means of the foot bellows pass a current of air of sufficient strength thru the entire apparatus. The strength of the current of air may be regulated by the globe valve so as to blow out the desired proportion of the light seed. The light seed is blown out thru the top of the tube and the heavier seed falls back into the seed receptacle. The degree of separation may be controlled accurately by means of the valve, the length of the tube, and the working of the foot bellows. A much more complete separation may be made by the use of a long tube than where a short one is used.

This simple apparatus serves to completely eliminate the evil results associated with the use of light and inferior seed. It is thoroly practical in every way, and delicate enough in its operation to separate the smallest kinds of seeds according to their individual specific gravity. One apparatus is sufficient to separate seed for an entire community, a plan which is being followed in some cases. A pound of seed may be separated in less than half an hour. Thus it is seen that the apparatus and cost of operating are very small and not sufficient to prevent any tobacco grower from eliminating all light and poorly developed seed, in this way not only increasing the yield, but also improving the uniformity and quality of his crop.

DISEASE RESISTANCE.

In practically all fields producing diseased tobacco plants where the writers have made observations some degree of immunity has been noticed in individual plants which have been found growing among badly diseased plants on infected soil. These cases of immunity could not be explained on the ground of any differences in treatment, but their resistance to disease was evidently inherent in the individual plants. The same conditions have been found by other investigators and workers in other farm crops, and from these resistant individuals many immune strains have been developed. Among the most notable are the variety of wilt-resistant cotton, improved by Mr. W. A. Orton and Mr. Rivers, and the Iron cowpea, which is resistant to root-knot caused by nematodes, improved by Dr. H. J. Webber and Mr. W. A. Orton. The transmission of this immunity found in individual plants has made it possible to develop immune strains, and in that way to produce thoroly healthy crops on disease-infected soils.

In most cases where immune plants occur, if seed is saved from a large number of such plants some of them will be found to transmit their resistance to the progeny uniformly and thus give rise to the easiest known method for the control of certain plant diseases.

In the case of tobacco, the seed of the immune plants must be saved, with precautions to avoid cross-pollination, to insure the best results. In the season of 1903 the writers made selections of plants in several tobacco fields in the Connecticut Valley which showed immunity to the tobacco wilt. These plants stood out very plainly and strikingly in the diseased sections of the field, making a normal growth, and were apparently not affected by the wilt in any way, while plants growing all around them were so badly diseased that they produced no tobacco, and many of them died before maturing seed. Seed was also saved from some of the diseased plants that reached maturity. Two rows were planted the following year on the infected soil, one from seed of a resistant plant and the other from seed of an immune plant, with the results shown in Plate IX, figure 2. In this instance, by reason of the foregoing and other observations, it was found that complete resistance to the wilt was obtained by one year's selection.

A wilt in tobacco occurs in North Carolina which is evidently a parallel case with the one found in Connecticut, and in all probability could be controlled in the same way.

One of the most serious diseases affecting tobacco at present is the root-knot caused by nematode worms. Tobacco seems to be particularly susceptible to the attacks of nematodes, and many crops are more or less seriously affected by this enemy. There is no known remedy for this pest that is applicable in a practical way to field conditions. Soil-sterilization methods are used successfully in plant beds or in greenhouses, but such treatment is rather too expensive to be used on large fields. The most practicable method for the control of this disease seems to be in the way of securing immune strains of tobacco by seed selection and breeding. The writers have selected a large number of individual plants that showed immunity in the field, and the seed of these selections will serve as a basis for experiments in the production of nematode-resistant types. The complete success of other workers in obtaining resistance to nematodes in varieties of sugar beets and cowpeas is good evidence that similar results may be obtained in their efforts to obtain resistance to this enemy in tobacco. The Iron cowpea shows strong resistance to the nematode when planted on badly infected tobacco fields, and for this reason can be highly recommended to tobacco growers for use in this connection.

The mosaic disease causes very serious injury in tobacco fields in many parts of this country. The writers believe, from indications observed during the past two years, that it will be possible to develop strong, vigorous strains of tobacco which will be largely resistant to this disease. In the case of some Maryland selections, resistance to the mosaic disease seems to have been transmitted in a large degree to the progeny of certain vigorous strains. In two plats grown side by side under uniform conditions, one from seed of a parent plant affected with mosaic disease, the other from a perfectly healthy one, the following results were obtained: Plat 1, grown from the seed of the mosaic plant, showed 80 per cent of diseased plants in the field; plat 2, grown from the seed of a perfectly healthy plant, showed less than 20 per cent of diseased plants. It may be impossible to entirely eradicate this disease by the production of immune varieties, owing to the peculiar nature of the malady, but these figures, which have been duplicated many times, show very conclusively that by the development of stronger and hardier types of tobacco, especially where heavy seed is used for sowing, it will be possible to gradually reduce the percentage of mosaic plants in ordinary tobacco fields.

There are numerous tobacco diseases which the writers believe may be largely eradicated by producing immune strains. It is the intention of the Office of Plant Breeding Investigations to take up work with as many of these diseases as seems practicable and endeavor by selection to produce resistant types wherever it is possible to do so.

A NEW VARIETY PRODUCED BY SEED SELECTION.

UNCLE SAM SUMATRA.

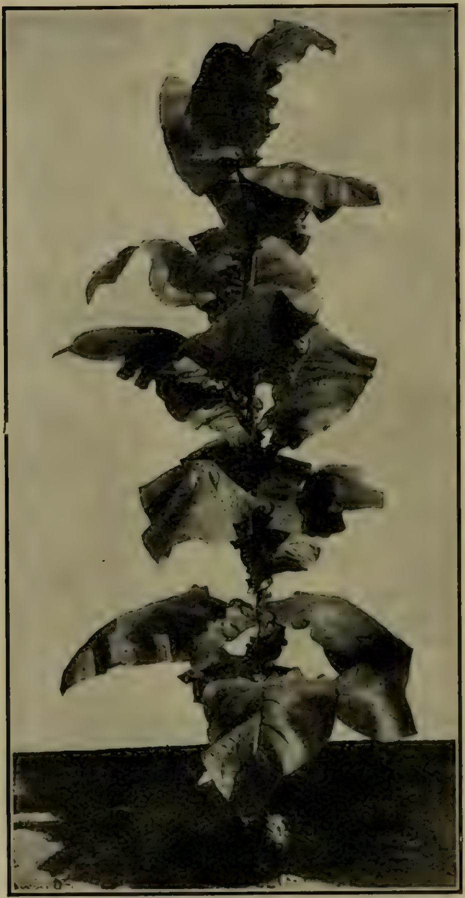


FIG. 9.—Typical plant of Uncle Sam Sumatra tobacco, originated by the Department of Agriculture in the Connecticut Valley from Florida-grown seed and now being extensively grown for cigar-wrapper production. The shape, size, venation, stretch, color, gloss, and other characters are specially well suited for cigar wrappers. This variety yields a large number of the best grades of wrappers, and is very uniform in all characters. It is a vigorous-growing plant, of early maturity and small seed production.

The original plants from which the variety of tobacco known as Uncle Sam Sumatra has been produced by seed selection were grown under shade on the plantation of the Connecticut Tobacco Corporation, near Tariffville, Conn. The first selections were made in the season of 1903 on this plantation in a field the plants of which were grown from seed originally brought from Florida. The Florida seed was produced by plants which were grown from seed originally imported from the island of Sumatra. In a careful study of the Connecticut-grown Sumatra crops in 1903 a number of distinct types were discovered, some of which were evidently very undesirable, while others were apparently desirable. A striking illustration of two of these types is shown in Plate VIII. The seeds of typical plants of these types were saved under bag and tested in 1904 in an experimental field of 4 acres on the Indian Head Plantations, at Granby, Conn. Further tests of the Uncle Sam variety in the season of 1905 in the Indian Head Plantation experimental field and in other fields in the Connecticut Valley and of plants of this variety grown in Florida from Connecticut-grown seed have demonstrated the value of this variety for growing under shade for the production of cigar wrappers. The original plants of the Uncle Sam variety showed striking variations from the generally accepted type of Sumatra tobacco, but were believed to more nearly approach the ideal of a desirable cigar-wrapper variety than other types. In the experimental stages the plants belonging to this type were classed as type 3 and called Sumatra to distinguish it from the other types. As soon as its commercial importance was established it was decided to call it the Uncle Sam variety. This name was considered appropriate from the fact that it is probably a striking variation produced by the effect of the change of climatic conditions consequent on the introduction of Sumatra-grown seed into the United States, and while it was discovered in the Connecticut Valley it appears probable that it can be successfully produced under shade in Florida.

The striking characteristics of this variety are extremely round leaves of fine texture, small fine veins growing at right angles from the midrib, the large number of leaves borne by the individual plants, and the wonderful uniformity of size and shape of leaves from the base to the top of the plants. In crops raised from the seed of this variety a large proportion of light-colored wrapper leaves are produced, which when wrapt on cigars have a smooth, glossy appearance. The leaves show uniformly a good burn in all practical and experimental tests, and there is no undesirable taste or flavor present or noticeable when the wrappers are smoked on cigars. The leaves have a peculiar and very characteristic habit of growth, standing out almost at right angles near the stem, and then drooping slightly near the tips. The quantity of seed produced by plants of this variety is very small, and very few and small suckers develop at any time during the growing season. In figure 9 is shown a typical plant of this variety, while figure 10 shows a typical leaf of this variety grown from self-fertilized seed.

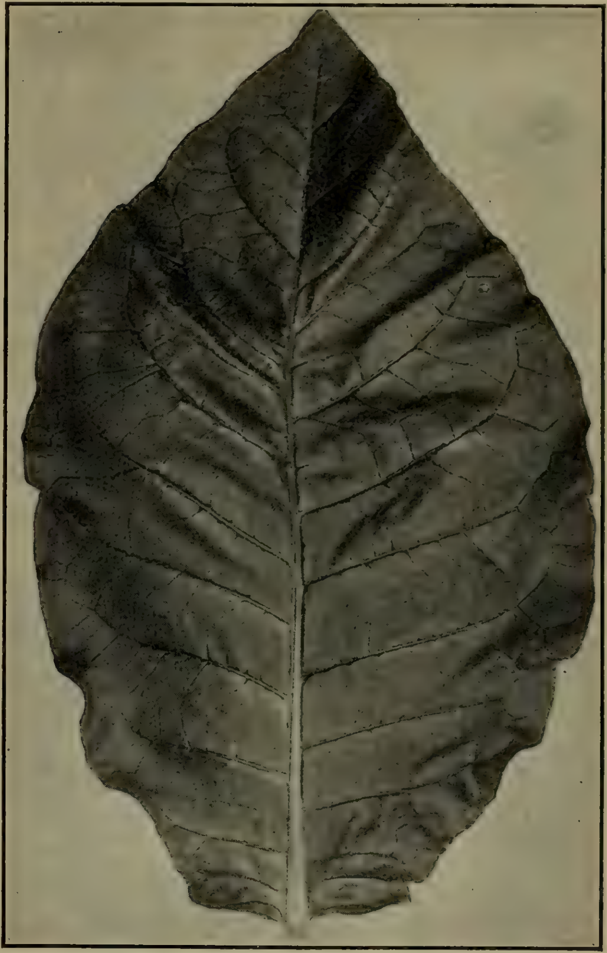


FIG. 10.—Typical leaf of Uncle Sam Sumatra tobacco, showing the ideal shape for cigar-wrapper manufacture. The veins are small and stand out almost at right angles to the midrib, which is very important for the economical cutting of wrappers.

The pedigree record of the original plants and their progeny shows an average production of 21 leaves to the plant, having an average length of 20½ inches and a width of 14½ inches. The average number of suckers is three and the size small. The average height of plants is 6 feet, and the average period from the date of setting out the plants in the field to the time of harvest is ninety days. The length of internode is 3½ inches and the circumference of stem 3½ inches. The plants have been particularly free from the attacks of fungous diseases, and the leaves have the necessary stretch, or elasticity, and strength to cover the cigar well without injury. The yield of wrappers in the manufacturing process has been exceedingly large and of the best quality.

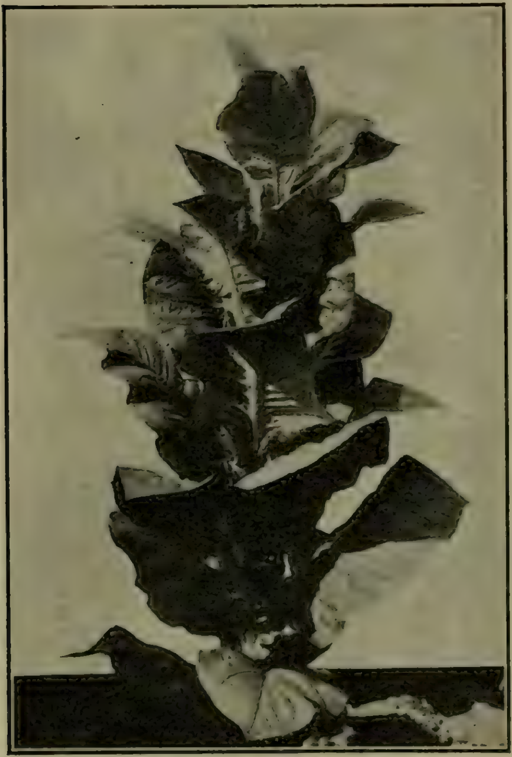


FIG. 11.—Typical plant of the Cooley Hybrid tobacco. Connecticut Havana Seed, female parent; Sumatra, male parent. The hybrid retains the habit of growth and adaptability to Connecticut Valley conditions of the mother parent, combined with the improved shape, size, venation, and other characters of the male parent.

NEW VARIETIES PRODUCED BY HYBRIDIZATION AND SEED SELECTION.

THE COOLEY HYBRID.

The history of the origin of the Cooley Hybrid is as follows: Select plants of the Havana Seed variety grown by Mr. D. P. Cooley, Granby, Conn., were used as mother parents. Several flowers on these plants were emasculated at the proper time and pollinated with pollen produced by plants grown from Connecticut Sumatra seed in the season of 1903. From the plants grown from this seed, selections of the most desirable were made in 1904. From this crop typical seed plants were again selected, and the plants raised from this seed in 1905 showed as great uniformity as ordinary crops of the mother Havana Seed variety, so that the hybrid can be said to be fixt, and seed in small samples has been distributed to interested growers. An illustration of the Cooley Hybrid plant is shown in figure 11, while a leaf of this variety is shown in figure 12. Illustrations of the Cooley Hybrid tobacco grown under shade are shown in Plate X.

The Havana Seed variety has long, rather pointed leaves with large veins. Only the tips of these leaves are suited to cigar-wrapper manufacture, the middle and basal portions lacking the necessary quality for good wrappers. This portion of the leaves is used for binders and in some cases for blending with cigar-filler tobacco. Inasmuch as the value of the tobacco depends on its capacity for producing cigar wrappers, it is highly desirable and important that as much of the leaf be utilized for wrapper purposes as possible. By crossing this acclimated variety with the standard Sumatra variety a hybrid was secured which produces short, broad, well-rounded leaves with fine veins. In other words, the hybrid combines the hardy and acclimated characters of the Havana Seed with some of the important characters of the Sumatra variety. From the variations in the plants of this hybrid it has been found possible to produce about the type of plant that is best suited to cigar-wrapper manufacture which can be grown under the soil and climatic conditions of the Connecticut Valley.

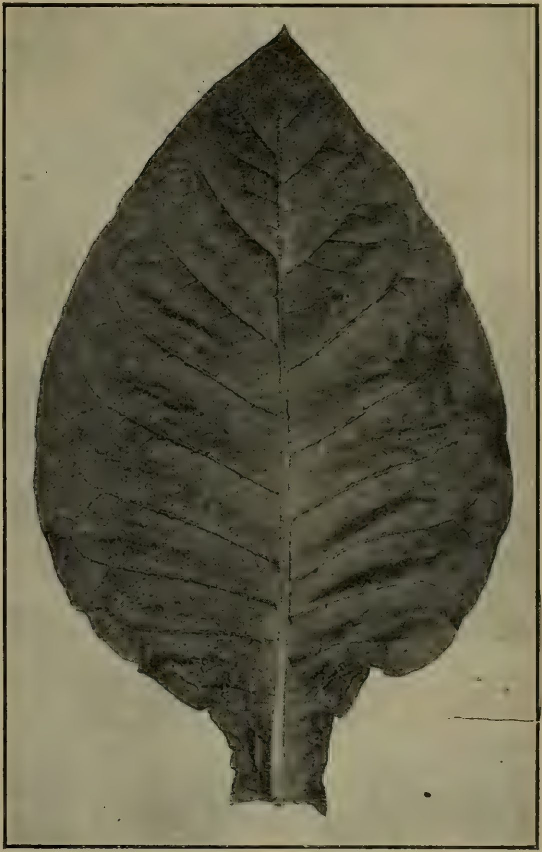


Fig. 12.—Typical leaf of the Cooley Hybrid tobacco. Connecticut Havana Seed, female parent; Sumatra, male parent.

The general characters of the Cooley Hybrid distinguishing it from the mother Havana Seed variety are increased number of leaves; shorter, broader leaves with very small, fine veins; reduced seed production, and more even texture of leaf from tip to base. The average number of leaves is 16; length, 27 inches; breadth, 17½ inches; shape, very round; number of suckers, 2; size of suckers, small; height of plant, 29 inches; circumference of stem, 2¾ inches; length of internode, 2 inches; time of maturity, ninety-five days.

It is necessary that the seed of this hybrid be saved under bag to avoid the possibility of cross-pollination. If the seed is crost with other plants, particularly with plants belonging to other varieties grown in a region, it is probable that there will be considerable breaking up in type and consequent deterioration of the value of the variety for cigar-wrapper production. It is likely that more or less variation will be developed in crops of this variety for several years, but that this variability will not be very marked. Small crops ought to be grown at first, even in the Connecticut Valley where the variety was produced. From these crops selections can be made in accordance with the directions given in this bulletin under the head of "The selection of seed plants," whereby acclimated strains of this variety adapted to local conditions, which will be an improvement over the present variety, can be secured.

THE BREWER HYBRID.

The history of the origin of the variety known as the Brewer Hybrid is as follows: Plants of the Connecticut Broadleaf variety raised from seed of the strain grown by Mr. N. S. Brewer, Hockanum, Conn., were crost in 1903 with pollen secured from plants grown in the Connecticut Valley from imported Cuban seed. Many crosses were also made in 1904. The plants raised from the hybrid seed in 1904 showed that a marked change had been effected by hybridization. The hybrid plants produced short, broad leaves of fine, even texture with small fine veins, an increased number of leaves with little increase in the height of the plants and, in some cases, a much improved type of plant for cigar-wrapper production.

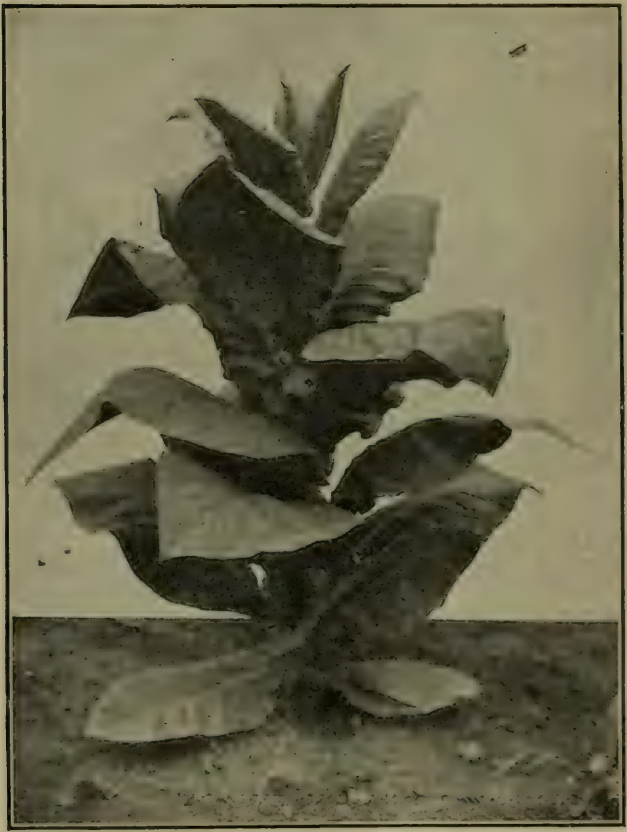


FIG. 13.—Typical plant of the Brewer hybrid tobacco. Connecticut Broadleaf, female parent; Cuban, male parent.

Selections from the crop of 1904 were grown in 1905, and one strain in particular showed such fixity of type that it may be considered ready for distribution to growers.

In the Connecticut Broadleaf tobacco the large size of the leaves is correlated with large veins and rather coarse and inferior basal portions of the leaves. These basal parts of the leaves are only suitable in most cases for cigar binders and for blending with fillers. As in the case of the Havana seed variety grown in this valley, the tips of the leaves produce the high-grade wrappers. It has long been recognized that a most important problem was the production of a smaller leaf with more uniform texture adapted for cigar-wrapper manufacture.

The Brewer Hybrid possesses many important characters that are distinct improvements over the Broadleaf variety. The average number of leaves is 21; length of leaves, 27½ inches; width, 19¾ inches; shape, very round; height of plants, 42 inches; circumference of stem, 2½ inches; length of internode, 2 inches; number of suckers, 2, of medium size. The time of maturity is eighty-five days. The suckering habit of the hybrid is rather unsatisfactory at the present time, for it seems to inherit the suckering tendency of the Cuban tobacco; but as some of the plants in this variety have been found to be comparatively free from suckers there is little doubt that nonsuckering strains can be developed by seed selection.

An illustration of the Brewer Hybrid is shown in figure 13. The typical shape and size of leaf of the hybrid are shown in figure 14.

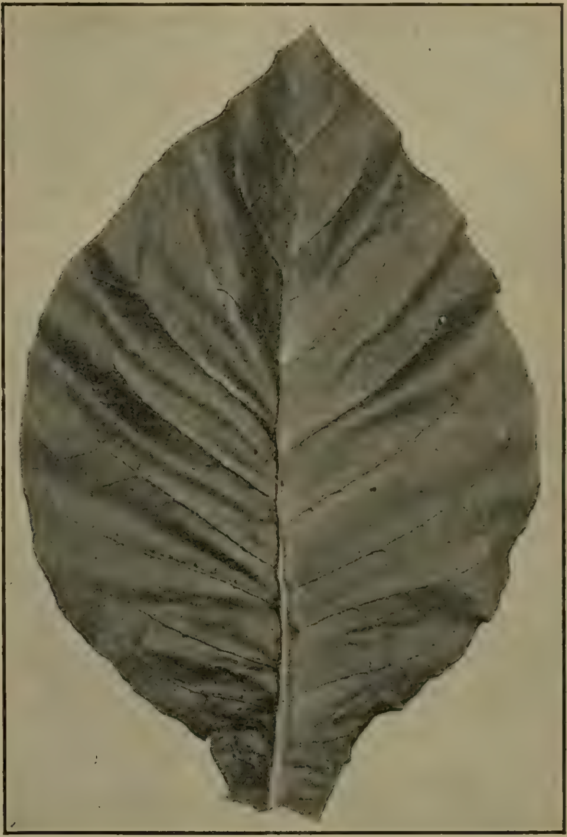


FIG. 14.—Typical leaf of the Brewer Hybrid tobacco. Connecticut Broadleaf, female parent; Cuban, male parent. The broad, very round leaf, fine venation, and other desirable characters of the Cuban tobacco are evident. These characters are combined in the hybrid with the burn, body, and taste of the Connecticut Broadleaf, the mother parent.

In the case of both the Cooley Hybrid and the Brewer Hybrid the tobacco can be sold by the growers and utilized by the manufacturers as improved Havana seed and Connecticut Broadleaf tobacco, respectively. In this way their production will not disturb the established market standards, but simply meet the demands of the market for improved wrapper and binder tobaccos to the benefit of both the grower and the manufacturer.

PLATES.

DESCRIPTION OF PLATES.

Plate I. Fig. 1.—A field of tobacco raised in Connecticut from imported Cuban seed. The result of using unselected Cuban-grown seed in the Connecticut Valley can be seen from a careful examination of this illustration, which shows a typical instance of the breaking up in the type of tobacco, due to the abrupt change of soil and climatic conditions. The branching type of plants bearing small leaves, constituting about one-third of the total number of plants in the field, was absolutely worthless for cigar-wrapper production, and many of the other variations from the normal Cuban type were of inferior quality, thus greatly reducing the yield and value of the crop. Fig. 2.—This uniform field of tobacco was produced by carefully selecting for seed production the best plants in the field shown in figure 1, and protecting the flowers from cross-pollination by the use of paper bags for two seasons. The undesirable types of plants were eliminated by this practise, and a uniform and desirable type secured, adapted to the soil and climatic conditions in Connecticut.

Plate II. Fig. 1.—This type of plant found in Connecticut fields grown from freshly imported Cuban tobacco seed was selected for propagation. Fig. 2.—The progeny of a single Connecticut Cuban seed plant, similar to figure 1, showing the uniformity of type of plants grown from self-fertilized seed, and the marked similarity of every plant to the type of the parent seed plant.

Plate III. The two uniform types of tobacco shown in this illustration were produced by sowing the seed of typical plants of these types growing in the same field and under similar conditions, free from cross-fertilization. These types of tobacco have been improved by careful selection of the best individual plants from year to year adapted to the purpose for which each type is produced. This experiment has demonstrated that the size, shape, venation of leaves, and other characters of tobacco plants can be propagated uniformly every year by judicious selection of seed plants of the type desired and the saving of the seed under bag.

Plate IV. The introduction of Florida-grown Sumatra tobacco seed in the Connecticut Valley was followed by a breaking up of the type of this tobacco. Among these types, few of which were desirable, and many undesirable, the two types shown in this illustration were found. The seeds of typical plants of these types were saved under bags, from which uniform strains were produced the following season. Both of these types of tobacco are valuable for growing under shade, and the two rows, one of each type, growing side by side, offer incontrovertible proof of the value of the methods of seed selection described in this bulletin in the production of uniform types of tobacco.

PLATE V. The two plants shown in this illustration, one bearing few small suckers, and the other many large suckers, represent the average variability of tobacco plants as regards the sucking habit. The plants are of the same variety, grow side by side in the row, are of the same age, and were grown under similar conditions in every respect. The leaves of the plant bearing few suckers are uniformly wide and round, while the leaves of the plant bearing large suckers are long and pointed, and have a tendency to vary markedly in size from the top to the base of the plant. This character is hereditary and consequently the suckering tendency may be controlled by tobacco growers by seed selection.

PLATE VI. Fig. 1.—The characteristic variability of tobacco plants as regards time of maturity, as shown in this illustration, is a matter of common observation in tobacco fields. The difference in the time of ripening of the leaves in the individual plants is of special importance in the tobacco crop, from the fact that in most cases all of the plants in the field are harvested at one time, and overripe or underripe leaves are inferior in quality. For this reason it is desirable that the plants mature uniformly thruout the field. Fig. 2.—The two rows of tobacco plants shown in this illustration demonstrate the possibility of securing uniform early or late strains of tobacco by seed selection. The two rows were grown under the same conditions.

PLATE VII. The character of the burn of leaves of individual tobacco plants varies in a marked degree, even among plants of the same variety grown under the same conditions and treated alike in the curing and fermenting processes. The two rows of plants in this illustration were grown from the bagged seed of two plants of the same field, growing side by side, one a plant producing good and the other poor burning leaves. These two progeny rows inherited uniformly the character of burn of the parent plants, demonstrating that it is possible to improve the quality of burn in a variety of tobacco by seed selection.

PLATE VIII.—The Connecticut-grown Sumatra tobacco produced a number of types of tobacco very different in all characters. The two rows of plants shown in this illustration are the progeny of two representative plants of these types, grown under the same conditions and showing the striking uniform inheritance of the characters of the parent plants.

PLATE IX. Fig. 1.—The row of tobacco plants in the left in this illustration, raised from heavy seed, shows the more vigorous growth, earlier maturity, and greater uniformity of plants raised from heavy seed, compared with the less vigorous plants raised from light seed shown in the row on the right. Fig. 2.—The row of small plants shows the dwarfing effect of the root-rot in Connecticut Sumatra tobacco, while the row of vigorous plants shows a resistant strain secured by seed selection.

PLATE X.—The two rows of the Cooley Hybrid tobacco shown in this illustration were grown under shade in the Connecticut Valley. The uniformity of plants and the shape, size, and character o fleaves shown in these rows are characteristic of this variety of tobacco. There is no decided breaking up in type following hybridization, as is the case in other plants.

O

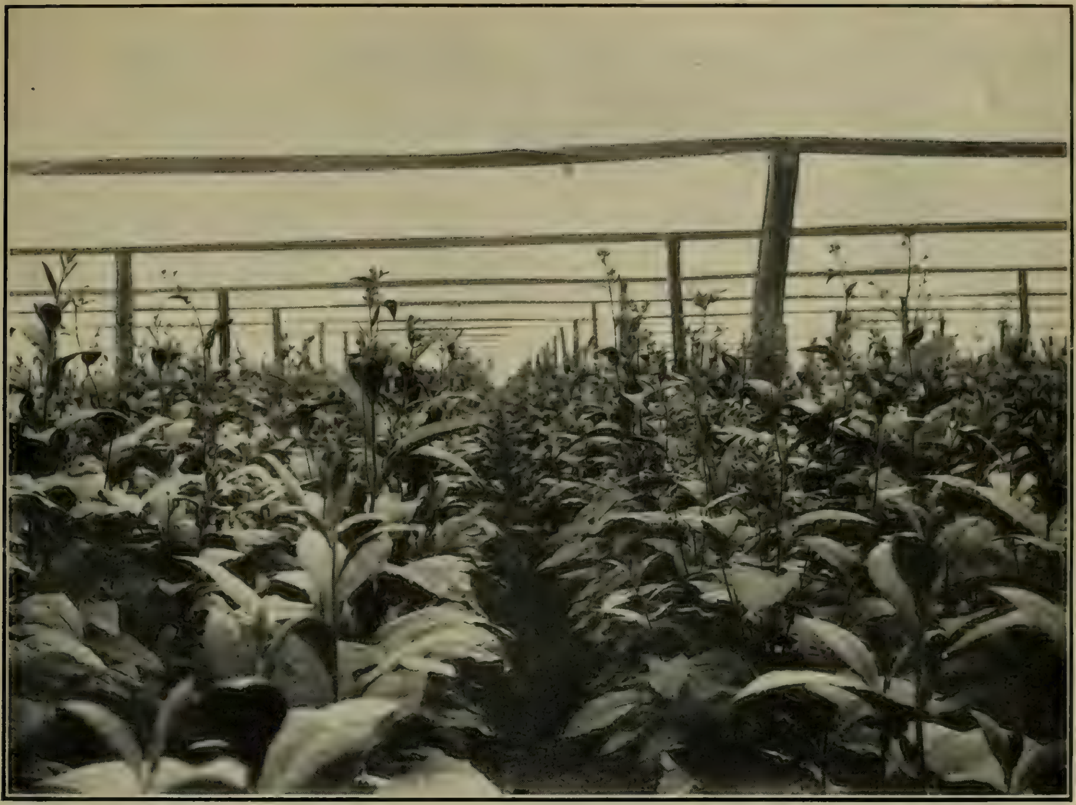


FIG. 1.—CONNECTICUT CUBAN TOBACCO PLANTS RAISED IN 1903 FROM UNSELECTED FRESHLY IMPORTED SEED, SHOWING GENERALLY UNDESIRABLE TYPES.

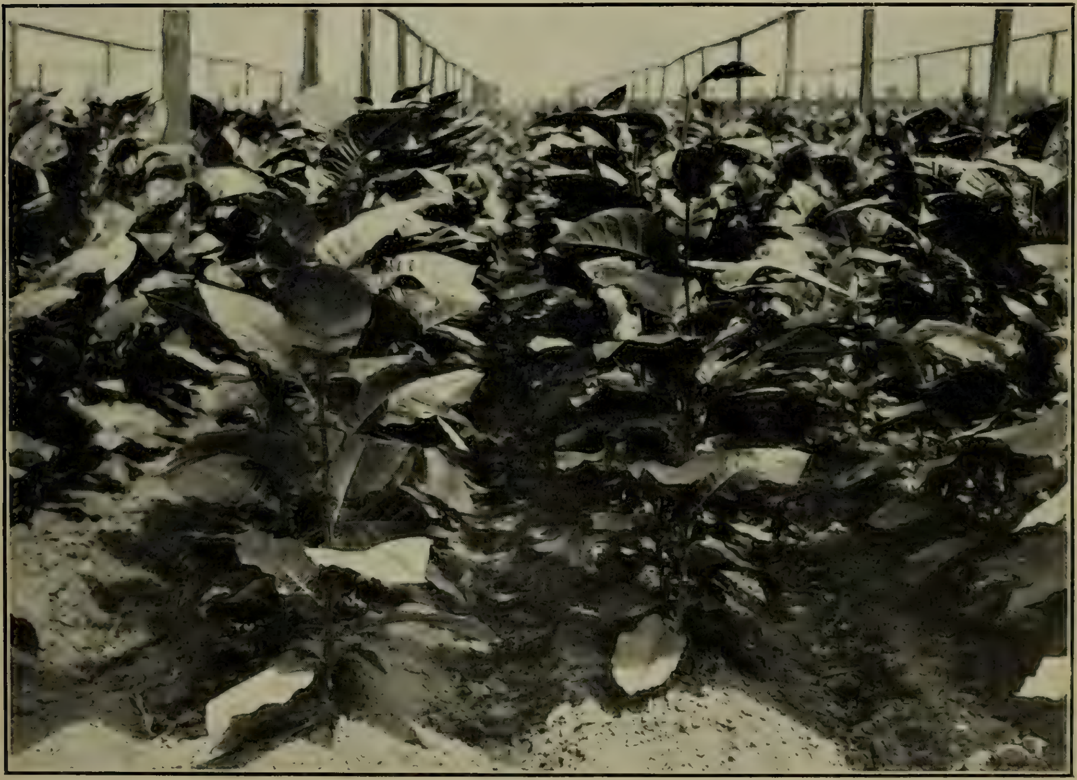


FIG. 2.—CROP OF CONNECTICUT CUBAN TOBACCO PLANTS RAISED IN 1905 FROM SEED SAVED FROM BEST PLANTS SELECTED FROM THE FIELD SHOWN IN FIGURE 1, SHOWING UNIFORMLY A DESIRABLE TYPE.

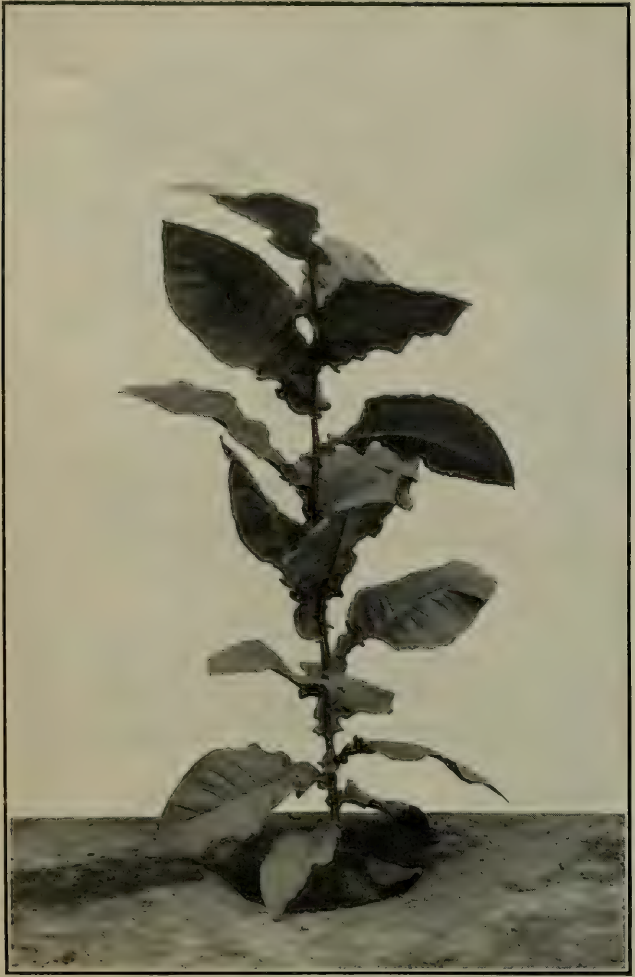


FIG. 1.—TYPE OF CONNECTICUT CUBAN TOBACCO PLANTS SAVED FOR SEED PRODUCTION.

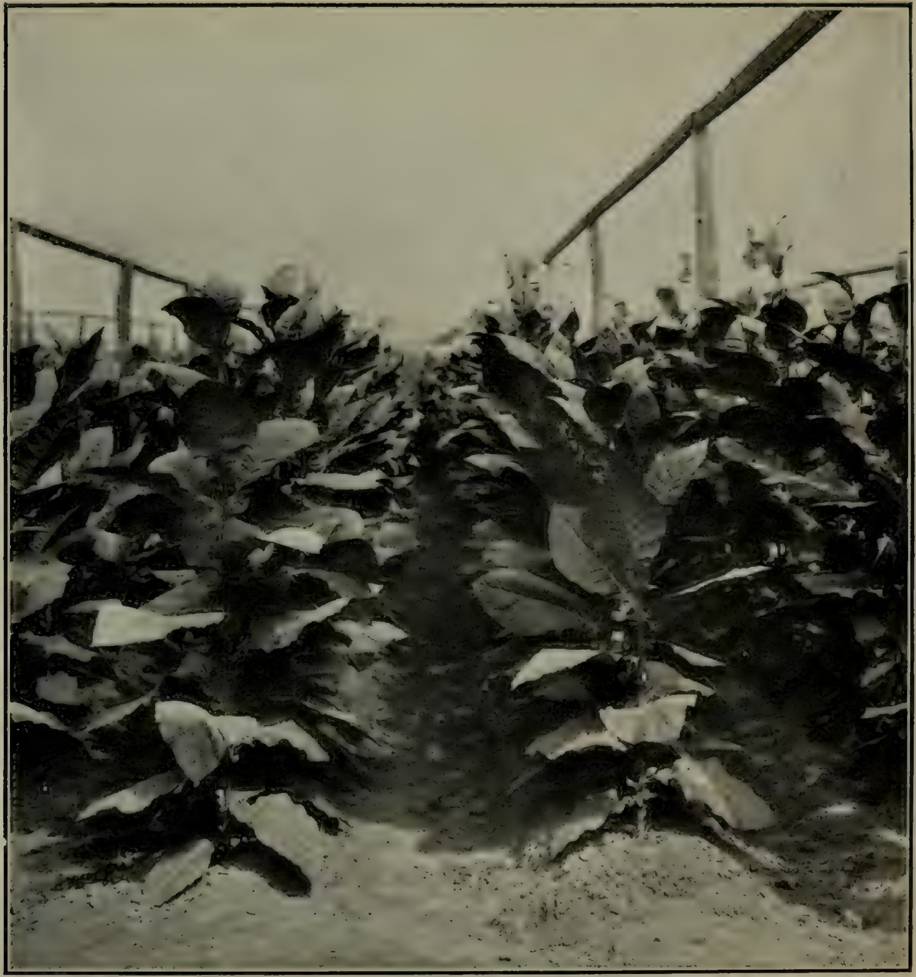
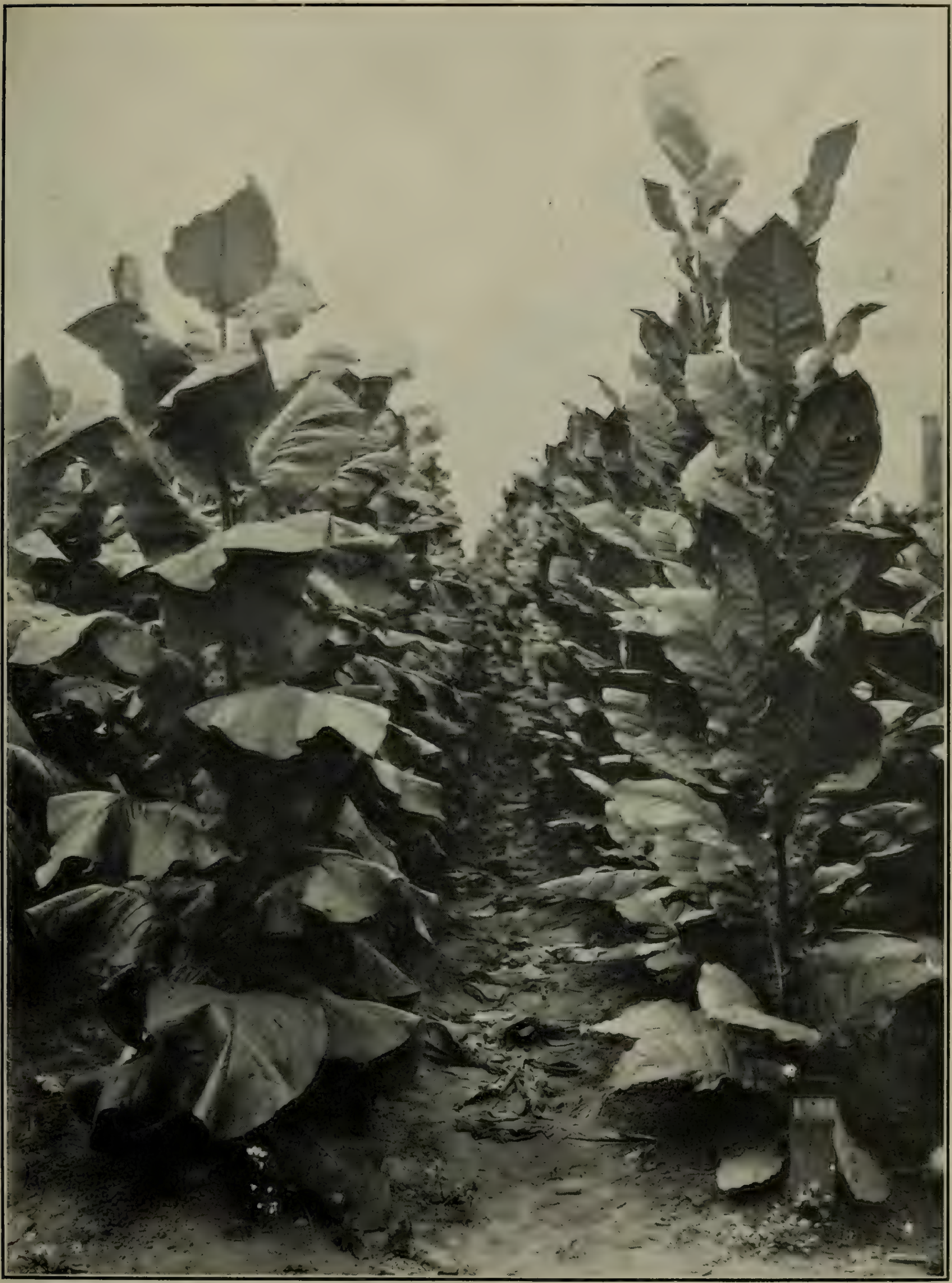
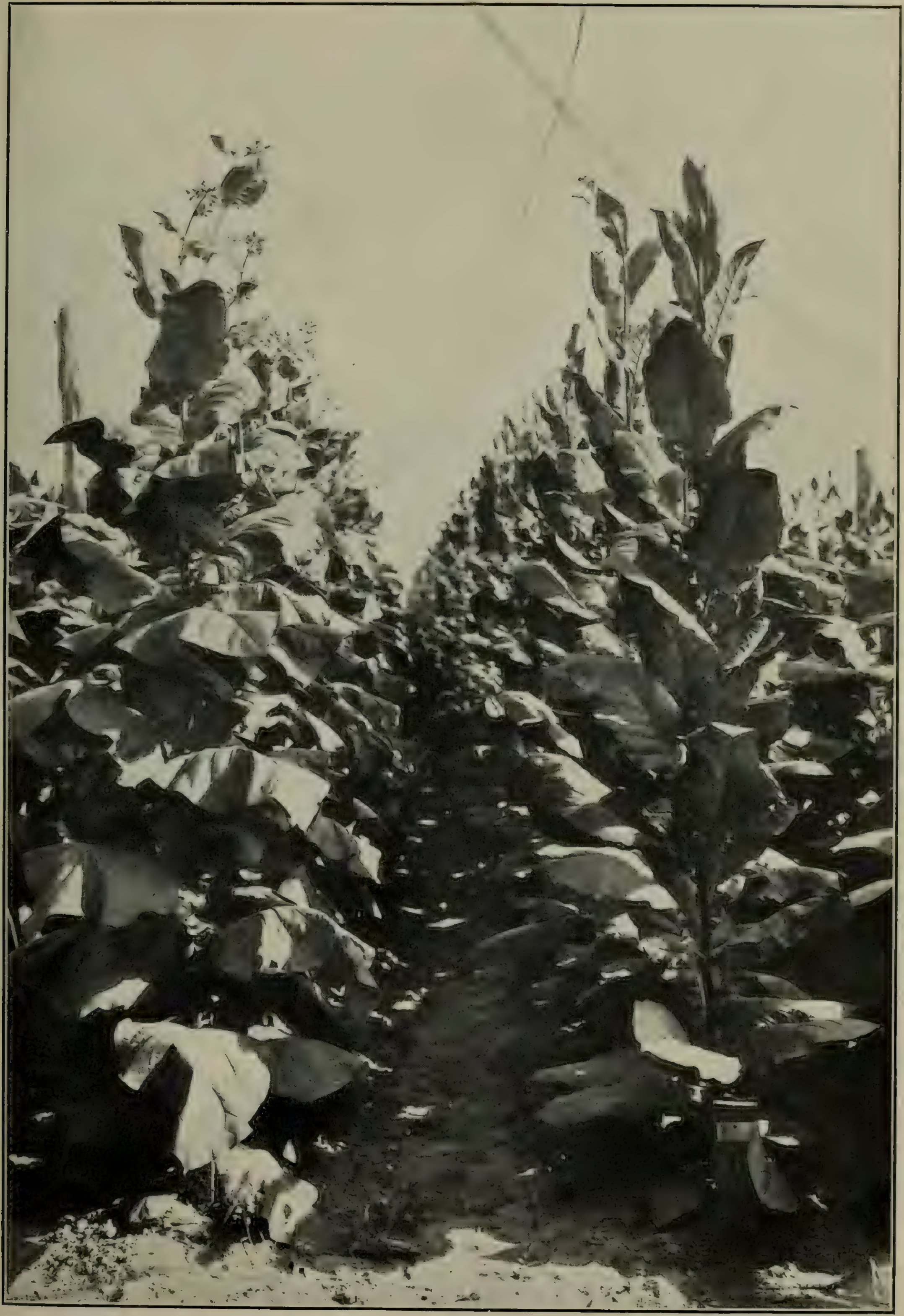


FIG. 2.—THE PROGENY OF A SINGLE PARENT PLANT OF CONNECTICUT CUBAN TOBACCO RAISED FROM SEED SAVED UNDER BAG.

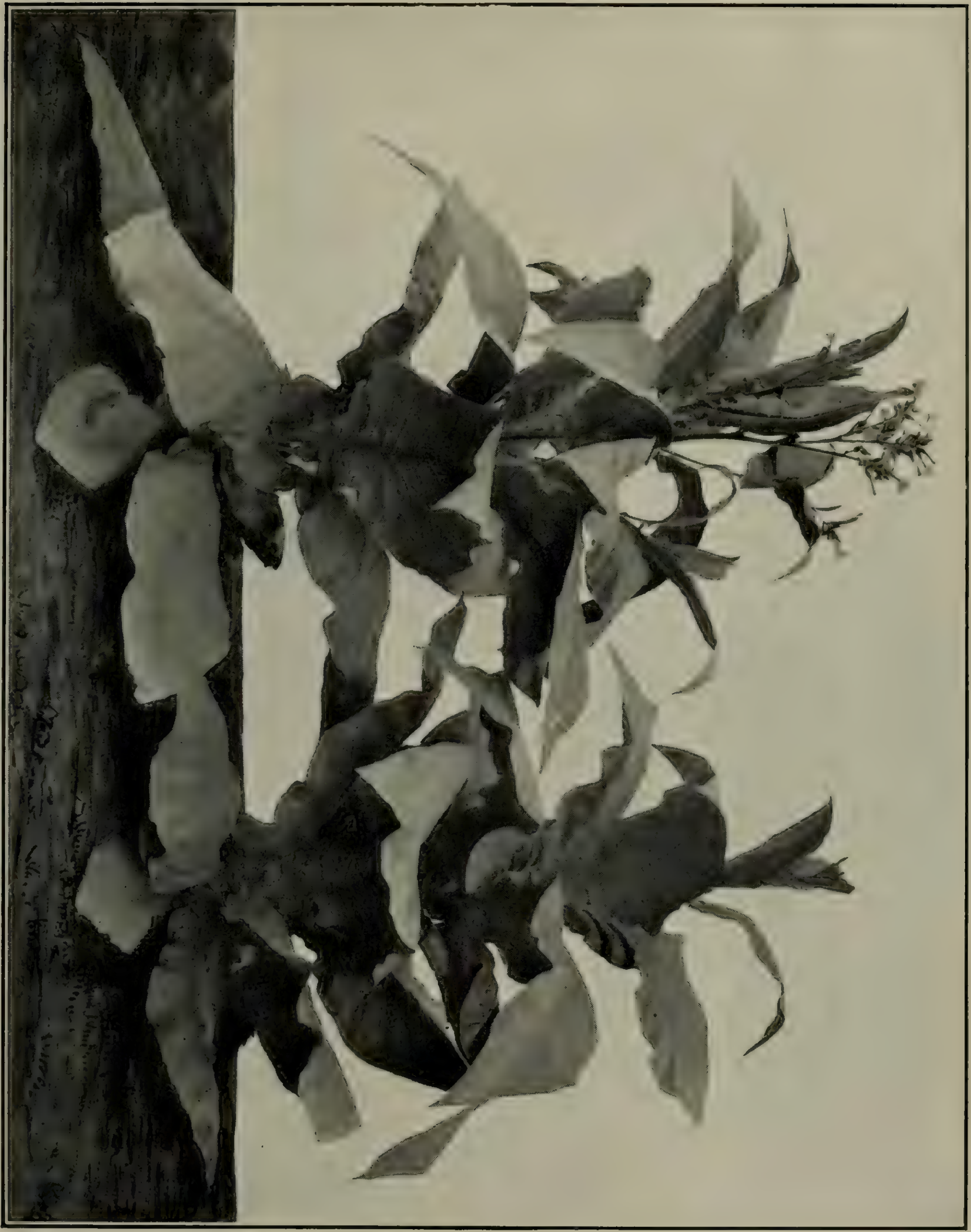


TWO TYPES OF CONNECTICUT CUBAN TOBACCO WHICH HAVE BEEN INBRED FOR THREE YEARS, SHOWING THE VALUE OF THE PRACTICE OF INBREEDING IN TOBACCO.



TWO ROWS OF CONNECTICUT SUMATRA TOBACCO SHOWING VARIATION IN TYPE. ROW ON RIGHT, GREENLEAF TYPE; ROW ON LEFT, SUMATRA TYPE.

PLATE V.



TWO TOBACCO PLANTS OF SAME AGE SHOWING VARIABILITY IN THE PRODUCTION OF SUCKERS.

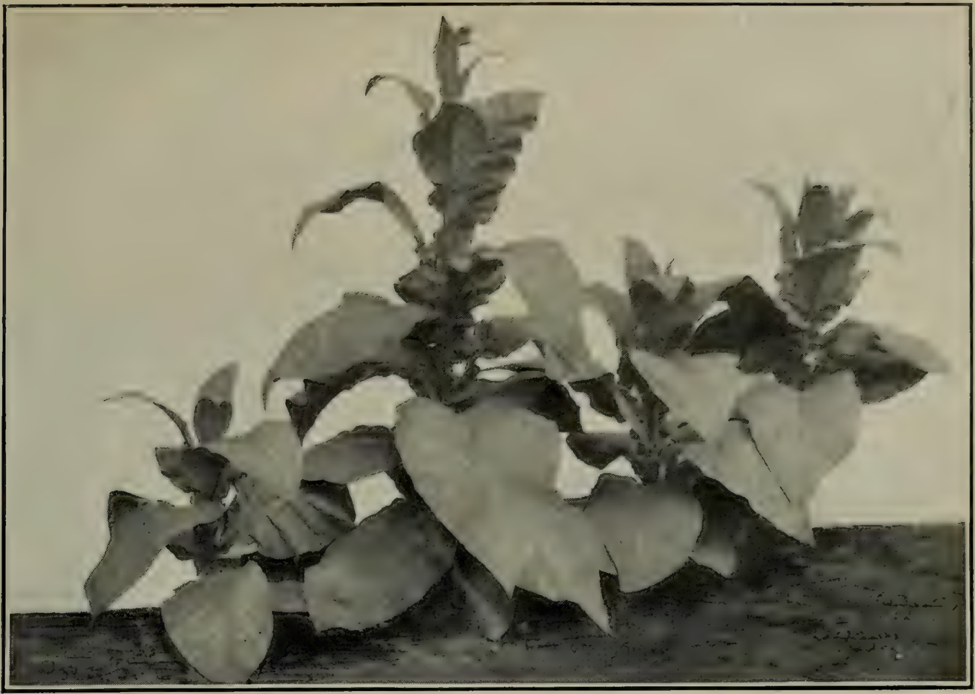


FIG. 1.—FOUR TOBACCO PLANTS OF THE SAME AGE, SHOWING VARIATION IN TIME OF MATURITY.

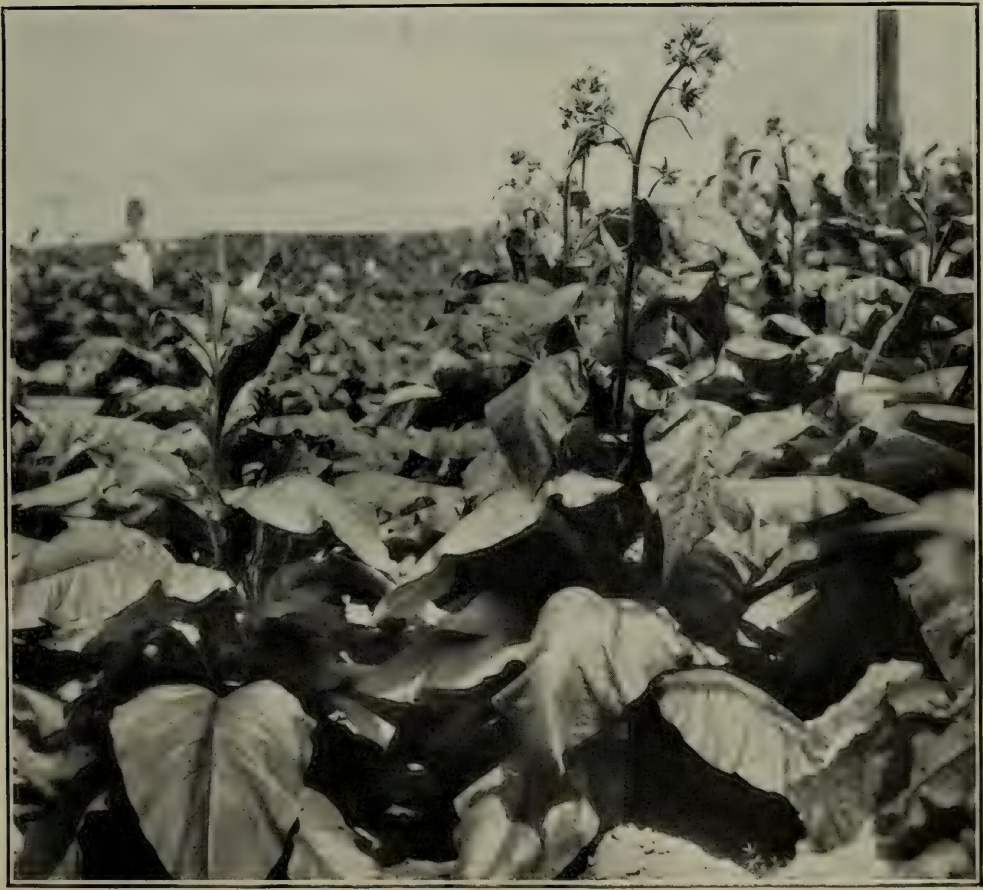
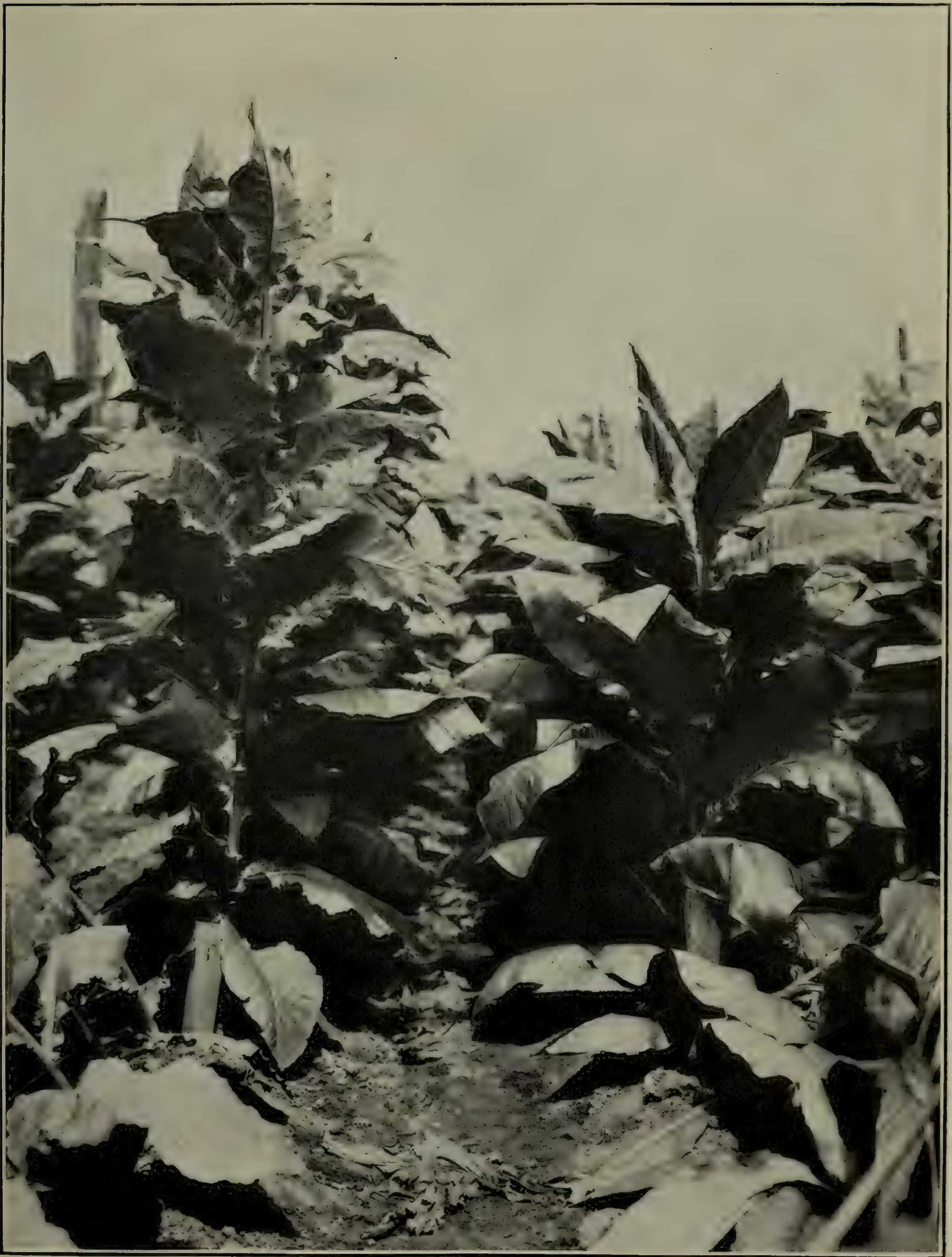
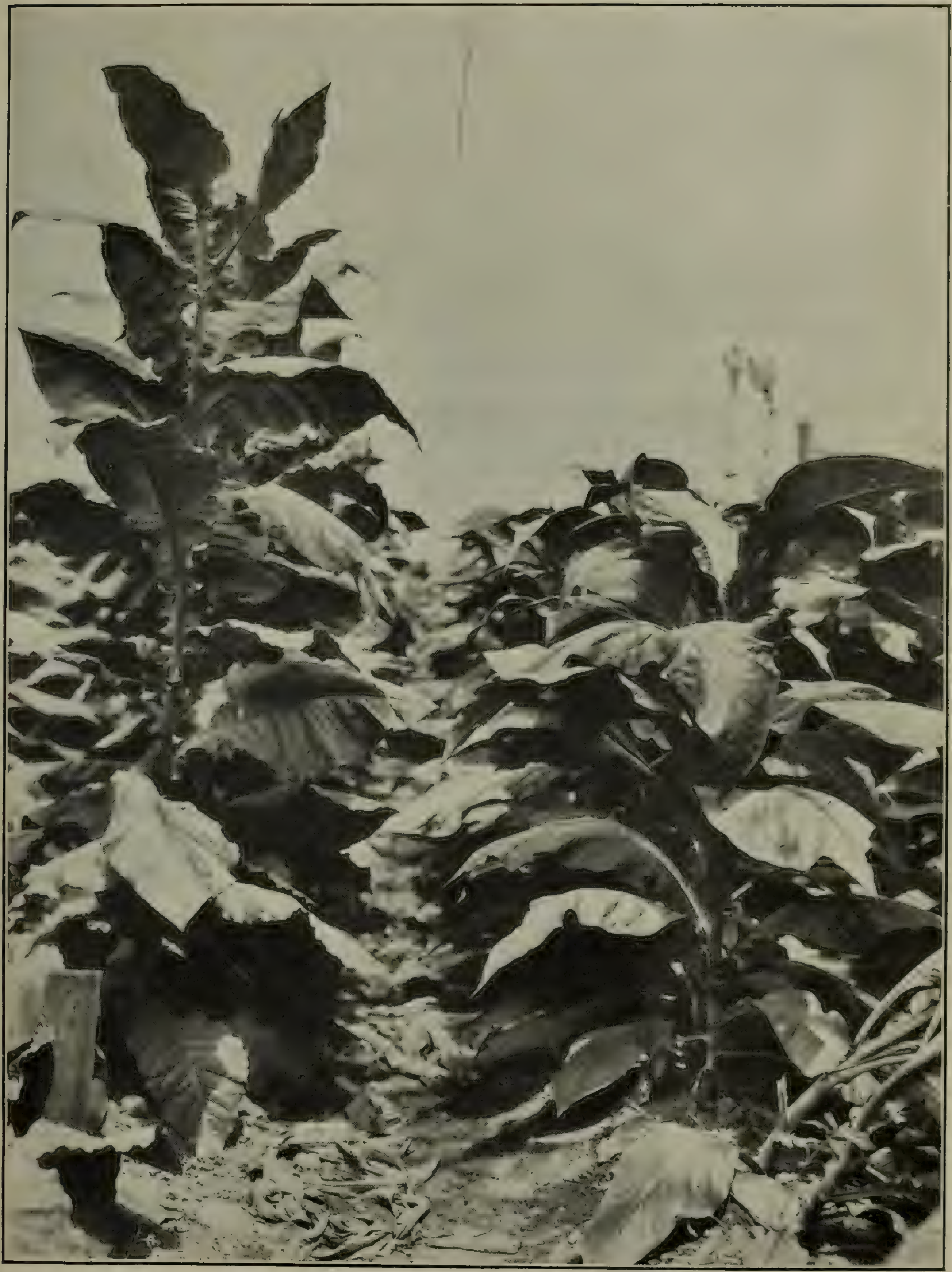


FIG. 2.—TWO ROWS OF CONNECTICUT BROADLEAF TOBACCO, SHOWING THE POSSIBILITY OF THE PRODUCTION OF EARLY STRAINS. ROW ON RIGHT RAISED FROM THE SEED OF AN EARLY PLANT, AND ROW ON LEFT FROM SEED OF A PLANT MATURING AT THE USUAL TIME.



TWO ROWS OF CONNECTICUT SUMATRA TOBACCO GROWN UNDER UNIFORM CONDITIONS. ROW ON RIGHT, POOR BURNING TYPE; ROW ON LEFT, PERFECT BURNING TYPE.



TWO ROWS OF CONNECTICUT SUMATRA TOBACCO SHOWING VARIABILITY IN TYPE. ROW ON RIGHT, BELGIAN TYPE; ROW ON LEFT, CRUMPLE TYPE.

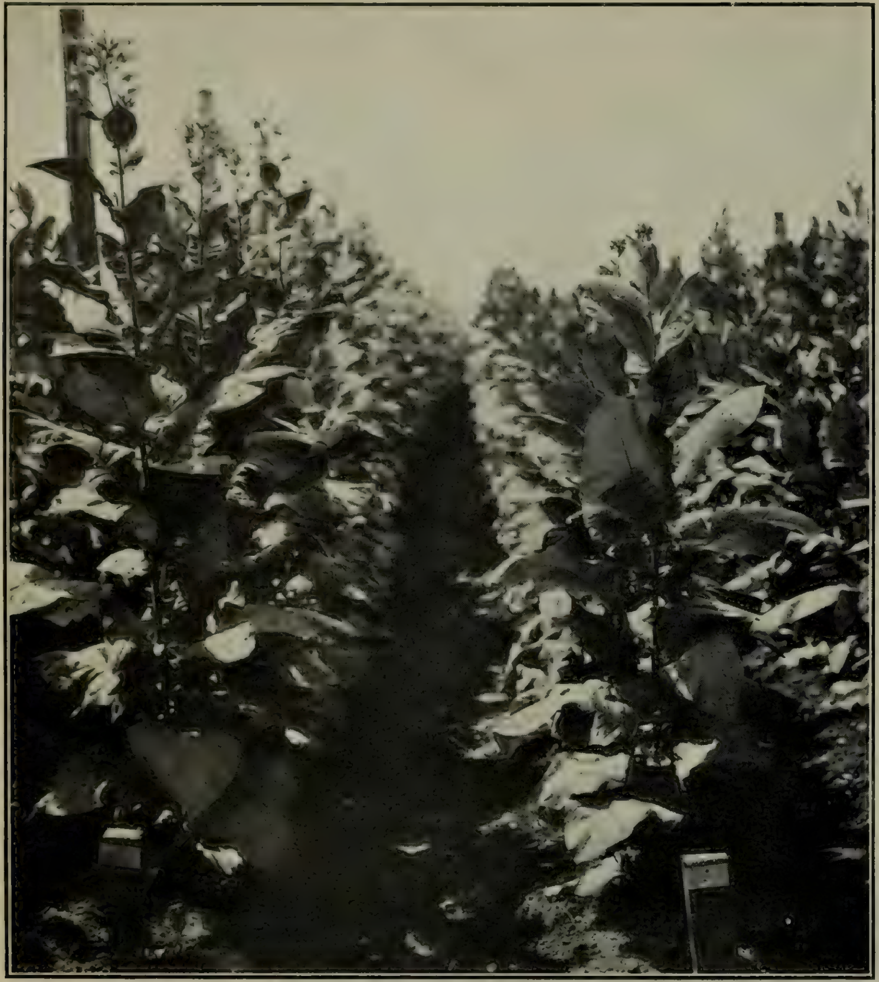


Fig. 1.—Two Rows of Tobacco Plants Showing the Results of the Use of Heavy and Light Tobacco Seed. Row on Left, Raised from Heavy Seed; Row on Right, from Light Seed.

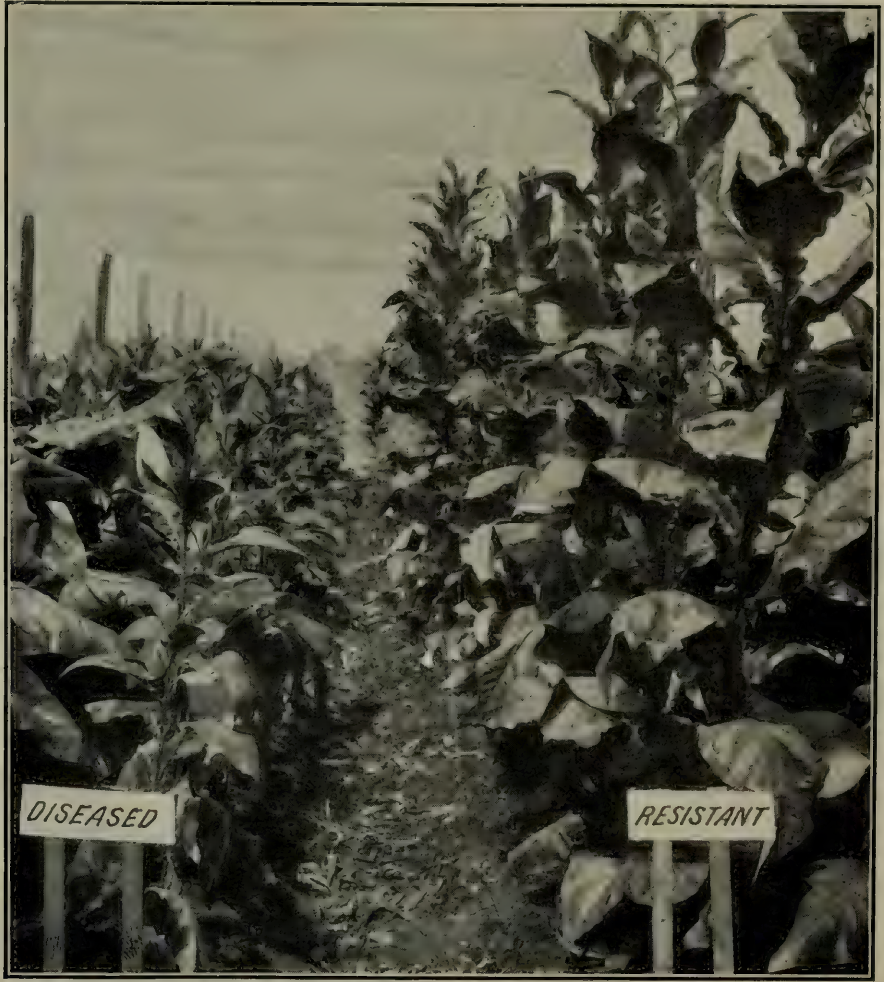


Fig. 2.—A Row of Connecticut Sumatra Plants Affected with Wilt in Comparison with a Row of Plants of the Same Variety Grown from Resistant Seed.

TWO ROWS OF COOLEY HYBRID TOBACCO GROWN UNDER SHADE.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 97.

B. T. GALLOWAY, *Chief of Bureau.*

SEEDS AND PLANTS IMPORTED

DURING THE PERIOD FROM DECEMBER, 1903, TO DECEMBER, 1905.

INVENTORY No. 11; Nos. 9897 TO 16796.

Issued March 15, 1907.

239411
3.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1907.

BUREAU OF PLANT INDUSTRY.

Pathologist and Physiologist, and Chief of Bureau, Beverly T. Galloway.
Pathologist and Physiologist, and Assistant Chief of Bureau, Albert F. Woods.
Laboratory of Plant Pathology, Erwin F. Smith, Pathologist in Charge.
Investigations of Diseases of Fruits, Merton B. Waite, Pathologist in Charge.
Plant Breeding Investigations, Herbert J. Webber, Physiologist in Charge.
Plant Life History Investigations, Walter T. Swingle, Physiologist in Charge.
Soil Bacteriology and Water Purification Investigations, Karl F. Kellerman, Physiologist in Charge.
Bionomic Investigations of Tropical and Subtropical Plants, Orator F. Cook, Bionomist in Charge.
Drug and Poisonous Plant Investigations and Tea-Culture Investigations, Rodney H. True, Physiologist in Charge.
Physical Laboratory, Lyman J. Briggs, Physicist in Charge.
Taxonomic Investigations, Frederick V. Coville, Botanist in Charge.
Farm Management Investigations, William J. Spillman, Agriculturist in Charge.
Grain Investigations, Mark A. Carleton, Cerealist in Charge.
Arlington Experimental Farm, Lee C. Corbett, Horticulturist in Charge.
Sugar-Beet Investigations, Charles O. Townsend, Pathologist in Charge.
Western Agricultural Extension, Carl S. Scofield, Agriculturist in Charge.
Dry Land Agriculture, E. Channing Chilcott, Agriculturist in Charge.
Pomological Collections, Gustavus B. Brackett, Pomologist in Charge.
Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge.
Experimental Gardens and Grounds, Edward M. Byrnes, Superintendent.
Seed and Plant Introduction, David Fairchild, Agricultural Explorer in Charge.
Forage Crop Investigations, Charles V. Piper, Agrostologist in Charge.
Seed Laboratory, Edgar Brown, Botanist in Charge.
Grain Standardization, John D. Shanahan, Expert in Charge.
Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge.
Subtropical Laboratory and Garden, Miami, Fla., Ernst A. Bessey, Pathologist in Charge.
Plant Introduction Gardens, Chico, Cal., Palemon H. Dorsett, Pathologist in Charge.
Cotton Culture Farms, Seaman A. Knapp, Lake Charles, La., Special Agent in Charge.

Editor, J. E. Rockwell.
Chief Clerk, James E. Jones.

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

SCIENTIFIC STAFF.

David Fairchild, *Agricultural Explorer in Charge of Seed and Plant Introduction.*
W. W. Tracy, sr., *Superintendent of Testing Gardens.*
John E. W. Tracy, *Assistant Superintendent of Testing Gardens.*
O. W. Barrett, *Assistant.*
George W. Oliver, *Expert.*
C. V. Piper, *Agrostologist, in Charge of Forage Crop Investigations.*
J. M. Westgate, *Assistant Agrostologist, in Charge of Alfalfa and Clover Introduction.*
W. W. Tracy, jr., *Assistant Botanist.*
Frank N. Meyer, *Agricultural Explorer.*
Charles F. Wheeler, *Expert.*
A. B. Connor, *Special Agent.*
Nickolas Schmitz, *Special Agent.*
John H. Tull, *Special Agent, in Charge of Matting-Rush Investigations.*
Harold T. Nielsen, *Scientific Assistant in Agronomy.*
Walter Fischer, *Scientific Assistant.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., August 1, 1906.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 97 of the series of this Bureau the accompanying manuscript entitled "Seeds and Plants Imported during the Period from December, 1903, to December, 1905."

This manuscript has been submitted by the Botanist in Charge of Seed and Plant Introduction and Distribution with a view to publication.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

B. P. I.—231.

SEEDS AND PLANTS IMPORTED DURING THE PERIOD FROM DECEMBER, 1903, TO DECEMBER, 1905.

INTRODUCTORY STATEMENT.

This is the eleventh inventory of seeds and plants that have been gathered together by this Office, mainly from foreign countries, and represents two years of work.

It is not published to inform experimenters of plants that are on hand for distribution, because in the great majority of cases the plants and seeds listed have been imported for special problems upon which the Department is at work and they have been already assigned to their respective experimenters and are now, many of them, growing in some part of the country.

These inventories are historical records of the introduction of new plants, some of which have already started new industries in this country. In the past historians have as a rule disdained to consider the advent of a new crop as worthy of careful record, notwithstanding the fact that its arrival might exert a remarkable influence upon the development of the country. It is believed that the publication by the Government of such a record will avoid in the future for these new industries the uncertainty which now exists as to the time of arrival in America of some of our most important plant cultures, which were probably first introduced by the Department of Agriculture. To the large number of agricultural experiment station workers and others who are experimenting with the various introductions, these inventories will be almost indispensable.

As remarked in previous inventories no attempt is made to reform the nomenclature of the plants imported, for in many cases the identification of imported seeds and plants is impossible until several years after their introduction. They must first be grown and studied by specialists in the various plant groups, who are sure sooner or later to include them in their monographs, in which places, and not in such an inventory, botanists are accustomed to search for the most recent nomenclature.

This inventory represents not merely the names of and remarks regarding new plant introductions, but embodies often the notes made at the time of collection by agricultural explorers who have been kept at very considerable expense in the field. In the present case it includes in part the collections made by Prof. H. L. Bolley, of North Dakota, who was sent thru the flax-growing region of Europe in search of the best varieties of flax, especially to find one that was more resistant to the flax rust than those we already have. It covers a portion of the seeds and plants collected by Mr. Ernst A. Bessey during his travels thru a part of the Caucasus, the Crimea, and into Russian Turkestan. It includes a list of valuable new seeds which Hon. Robert P. Skinner very kindly secured in Abyssinia for the Department when sent as commissioner to King Menelik in 1904. The valuable collection of 100 European potato varieties, made by Prof. L. R. Jones, of the University of Vermont, is also included. This inventory includes also the results of Mr. Thomas H. Kearney's explorations in southern Tunis, where he was sent by the Office of Seed and Plant Introduction Investigations to study the date varieties of the Tunisian oases. The collection of date offshoots which Mr. Kearney secured is unique in that it was made after a careful examination of the palms while in full bearing. This is the first time that an agricultural explorer has been given the opportunity to spend the fruiting season in foreign date gardens, and Mr. Kearney's descriptions of the varieties collected in Tunis are from actual observation and not from hearsay. Dry land olives, pomegranates, pistaches, spineless opuntias, and drought-resistant fodder crops were also given attention by Mr. Kearney while in this interesting desert region. The collections made by Mr. P. H. Rolfs during his explorations of the vanilla-growing regions of Mexico are chronicled in this inventory, and the vanilla cuttings secured at that time are contributing their share toward the solution of the problem of vanilla culture in Florida.

A. J. Pieters,
Botanist in Charge.

Office of Seed and Plant
Introduction and Distribution,
Washington, D. C., August 1, 1906.

INVENTORY.

9897 to 10260.

From Russia. Received thru Prof. H. L. Bolley, November 24, 1903.

A miscellaneous assortment of seeds collected by Professor Bolley during the season of 1903, as follows:

9897 to 10167.	Linum usitatissimum.	**Flax.**
10168 to 10182.	Secale cereale.	**Rye.**
10183 to 10193.	Avena sativa.	**Oat.**
10194 to 10218.	Triticum vulgare.	**Wheat.**
10219 to 10222.	Hordeum vulgare.	**Barley.**
10223 to 10225.	Helianthus annuus.	**Sunflower.**
10226.	Bromus inermis.	**Smooth brome-grass.**
10227 to 10231.		**Wild grasses.**
10232 to 10235.	Medicago sativa.	**Alfalfa.**
10236 and 10237.	Ervum lens.	**Lentil.**
10238 to 10240.	Pisum sativum.	**Pea.**
10241 and 10242.	Cannabis sativa.	**Hemp.**
10243 and 10244.	Brassica napus.	**Rape.**
10245 to 10247.	Brassica sp.	**Mustard.**
10248.	Cucumis melo.	**Muskmelon.**
10249.	Citrullus vulgaris.	**Watermelon.**
10250.	Ribes grossularia (?).	**Gooseberry.**
10251.	Gleditschia sp.	**Honey locust.**
10252.	Coronilla varia.	**Crown vetch.**
10253.	Lotus corniculatus.	**Bird's-foot trefoil.**
10254.	Trifolium sp.	**Wild clover.**
10255.	Lathyrus sylvestris.	**Flat pea.**
10256 and 10257.	Vicia sp.	**Wild vetch.**
10258.	Vicia sp.	**Wild yellow vetch.**
10259.	Papaver sp.	**Poppy.**
10260.	Prunus sp.	**Cherry.**

10261 to 10263.

From Khojend, Russian Central Asia. Presented by Mr. E. Valneff to Mr. E. A. Bessey. Received December 18, 1903.

10261. Pyrus malus. **Apple.**

Seed from wild trees in the mountains.

10261 to 10263—Continued.

10262. Prunus divaricata. **Plum.**

Black variety. Seed from wild trees in the mountains.

10263. Prunus divaricata. **Plum.**

Yellow variety. Seed from wild trees in the mountains.

10264. Quercus suber. **Cork oak.**

From Mustapha, Algeria. Received thru Dr. L. Trabut, December 18, 1903.

10265 and 10266. Pistacia mutica. **Turpentine tree.**

From Smyrna, Turkey in Asia. Received thru Mr. B. J. Agadjanian, December 15, 1903.

10265. Very dark brown. **10266.** Very bright green.

10267. Pistacia atlantica. **Bitoom.**

From Duperre, Algeria. Received thru Mr. Franck Joly, December, 18, 1903.

10268. Pistacia terebinthus. **Terebinth.**

From Marseille, France. Received thru Mr. Claude Montel, nurseryman, by Mr. W. T. Swingle, August, 1903.

10269. Avena sativa. **Oat.**

From Mustapha, Algeria. Received thru Dr. L. Trabut, government botanist, by Mr. T. H. Kearney, December 18, 1903.

10270 to 10274.

From Åbo, Finland. Presented by Mr. Alarik Rosenberg, seedsman. Received September 25, 1903.

Seed from crop of 1903, grown on Hovirinha farm in St. Kerins county, state of Åbo and Björneborg, Finland.

10270. Hordeum vulgare. **Barley.**

10271. Avena sativa. **Oat.**

10272. Triticum vulgare. **Wheat.**

10273. Secale cereale. **Rye.**

10274. Pisum sativum. **Pea.**

10275 to 10283.

From Stockholm, Sweden. Secured by Mr. J. E. W. Tracy, thru the American consul at Stockholm, from the Governor of Lulea, Sweden. Received September 25, 1903.

10275. Hordeum vulgare. **Barley.**

10276. Hordeum vulgare. **Barley.**

10277. Triticum vulgare. **Wheat.**

10278. Avena sativa. **Oat.**

White.

10279. Avena sativa. **Oat.**

Black.

10280. Secale cereale. **Rye.**

10281. Cannabis sativa. **Hemp.**

10282. Phleum pratense. **Timothy.**

10283. Vicia cracca.

10284. PHASEOLUS RADIATUS. Mung bean.

From Beaukiss, Tex. Received thru Mr. John B. Lesheen, December 11, 1903. Grown in 1903 from S. P. I. No. 6430.

10285 to 10288.

From Paris, France. Received thru Mr. W. T. Swingle from the Jardin des Plantes, December 21, 1903.

Cuttings of four species of pistache, as follows:

10285. PISTACIA CHINENSIS.

10286. PISTACIA TEREBINTHUS. **Terebinth.**

10287. PISTACIA MUTICA. **Turpentine tree.**

10288. PISTACIA ATLANTICA. **Bitoom.**

10289 to 10308. VITIS VINIFERA. Grape.

From Erivan, Caucasus, Russia. Received thru Mr. E. A. Bessey, December 21, 1903.

10289. *Black Yezandari.*
10290. *Huseïni.*
10291. *White Saabi.*
10292. *Mskhali.*
10293. *White Kishmish.*
10294. *Khalili* (probably *Yellow Khalili*).
10295. *Shirshira.*
10296. *Kulami.*
10297. *Ambari.*
10298. *Gulyabi.*
10299. *Kyechmamasi.*
10300. *Shirazu.*
10301. *Yellow Yezandari.*
10302. *Goi-chezandaei.*
10303. *Sem-raz'-daet* (sevenfold).
10304. *Urza.*
10305. *Saäbi* (rose-colored).
10306. *Khatchabas.*
10307. *Ak uzyum* (white grape).
10308. *Red Kishmish.*

10309 and 10310.

From Tanegashima, Japan. Presented by Mr. R. Chester to Mr. R. B. Handy. Received December 12, 1903.

Native Japanese seeds as follows:

10309. **"Raishi."**

A kind of gourd. "Sow when other squashes are sown, covering the seed lightly with straw. Train on sticks."

10310. CUCURBITA sp. **"Kaboucha."**

A kind of gourd. Culture same as No. 10309.

10311 to 10314.

From Honolulu, Hawaii. Received thru Mr. J. G. Smith, Special Agent in Charge of the Hawaii Experiment Station, December 26, 1903.

Specimens of native yams, as follows:

10311. DIOSCOREA DIVARICATA (?). **"Hoi."**

Tubers 4 inches in diameter.

10312. DIOSCOREA DIVARICATA (?). **"Hoi."**

Axillary tubers.

10313. TACCA PINNATIFIDA. **"Pia."**

Tuber 5 inches in diameter.

10314. SMILAX SANDWICENSIS. **"Uhi."**

10315. LINUM USITATISSIMUM. **Flax.**

From Russia. Collected by Prof. H. L. Bolley in the season of 1903. Received December 21, 1903.

(Ramm, No. 2760.) Sample of *Dalgonetz* flax, crop of 1902, from Kharkof government.

10316. LINUM USITATISSIMUM. **Flax.**

From Russia. Collected by Prof. H. L. Bolley in the season of 1903. Received December 21, 1903.

Diriny Gorky flax (Sakowickz No. 1). (See No. 9989.)

10317. LINUM USITATISSIMUM. **Flax.**

From Russia. Collected by Prof. H. L. Bolley in the season of 1903. Received December 21, 1903.

Diriny Gorky (Sakowickz No. 2). Seed said to be the same pedigree as "No. 1," S. P. I. No. 10316.

10318. TRITICUM VULGARE. **Wheat.**

From Kharkof, Russia. Collected by Prof. H. L. Bolley in the season of 1903. Received December 21, 1903.

10319. TRITICUM VULGARE. **Wheat.**

From Kharkof, Russia. Collected by Prof. H. L. Bolley in the season of 1903. Received December 21, 1903.

10320. SECALE CEREALE. **Rye.**

From Russia. Collected by Prof. H. L. Bolley in the season of 1903. Received December 21, 1903.

10321. AVENA SATIVA. **Oat.**

From Russia. Collected by Prof. H. L. Bolley in the season of 1903. Received December 21, 1903.

10322. PISTACIA TEREBINTHUS. **Terebinth.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., December 30, 1903.

10323. PISTACIA VERA. **Pistache.**

From Catania, Sicily. Received thru Mr. Robert W. Heingartner, December 30, 1903.

10324. SOLANUM COMMERSONI. **Aquatic potato.**

From Marseille, France. Received thru Dr. E. Heckel, January 2, 1904.

"Tubers of the so-called 'aquatic potato' of Uruguay. This species from Uruguay is being experimented with by Doctor Heckel, of Marseille, who is breeding it with the ordinary potato and finds that it gives successive crops on the same soil without the necessity of replanting. It also gives abundant foliage, which he thinks may be used for green forage. He further points out that the bitter flavor of the skin will protect the potato against the depredations of subterranean enemies. Its keeping qualities during the winter are good. Very little rot appears, and rats are not fond of it. The special point, however, to be emphasized in connection with this new species is that the diseases of the potato do not attack it. One difficulty in its culture consists in the necessity of working over carefully the soil to an unusual depth, because the tubers are deeply buried in the soil. It flowers abundantly, beginning in June and ending in September, the flowers having a perfume similar to that of jasmine. Their odor on a hot day is perceptible for several meters. Planting takes place in southern France by means of whole or cut tubers in April and the harvest is in October. Doctor Heckel's experiments are reported upon in the following publications: Sur le Solanum commersoni Dunal, ou pomme de terre aquatique de l'Uruguay, in the Revue Horticole, No. 581, December, 1902, p. 200; Contribution à l'Étude Botanique de quelques Solanum Tubérifères, par M. Édouard Heckel." (*Fairchild.*)

10325. Hedysarum coronarium. **Sulla.**

From Malta. Received thru Dr. G. Borg, December 27, 1903.

"Dried roots of sulla covered with the root tubercles caused by *Bacillus radicicola.* These are imported in order to enable Doctor Moore to make cultures of the germ and ultimately to enable rational experiments to be carried out with this important forage plant, especially adapted to the poor soils, rich in lime, in our Southern States." (*Fairchild.*)

10326. Panax ginseng. **Ginseng.**

From Korea. Received thru the North Pacific Trading Company, 56 Fifth avenue, Chicago, Ill., January 7, 1904.

Seed guaranteed by the North Pacific Trading Company to be genuine imported seed.

10327. Andropogon sorghum. **Sorghum.**

From Durban, Natal. Received thru Messrs. Lathrop and Fairchild from Mr. Reuben W. Beningfield, January 14, 1904.

Native name *Mapela.* "Seed of a variety of sorghum from the east coast of Africa. This variety is that upon which the natives live, and according to Mr. Claude Fuller, entomologist of the Natal agricultural department, it has proved more resistant to a species of aphis which attacks the sorghum in that region than others which were growing side by side with it. This may prove of value in the sorghum regions of this country." (*Fairchild.*)

10328. Pistacia atlantica. **Bitoom.**

From Orléansville, Algeria. Received thru Yahia ben Kassem, January 14, 1904. Collected in the Sahara.

10329. Phaseolus radiatus. **Mung bean.**

From Cairo, Ga. Received thru Mr. J. B. Wight, January 14, 1904.

Grown from S. P. I. No. 6430.

10330. Avena sativa. **Oat.**

From Agricultural College, N. Dak. Received November 30, 1903.

Swedish Select. Grown by the North Dakota Agricultural Experiment Station from S. P. I. No. 9422.

10331 to 10339.

From Khojend, Russian Central Asia. Presented to Mr. E. A. Bessey by Mr. E. Valneff. Received January 21, 1904.

10331 to 10334. Vitis vinifera. **Grape.**

Cuttings of the best varieties of grapes grown in Russian Central Asia, as follows:

10331. *Tcharas,* or *Charas.*
10332. *White Kishmish.*
10333. *Black Kishmish.*
10334. *Maizi.*

10331 to 10339—Continued.

10335 to 10337. AMYGDALUS PERSICA. **Peach.**

Cuttings as follows:

10335. *Rugani gau* (or *gow*).

10336. *Shaftali-inzhir.*

10337. *Shaftali*, white.

10338. AMYGDALUS COMMUNIS. **Almond.**

Cuttings.

10339. JUGLANS REGIA. **Persian walnut.**

Nuts from trees growing at a considerable altitude, and should, therefore, be rather late in blooming.

10340 to 10342. VITIS VINIFERA. **Grape.**

From Nikita, near Yalta, Crimea. Presented to Mr. E. A. Bessey by Mr. Theophil Kalaida, head gardener of the Imperial Gardens at Nikita. Received January 29, 1904.

Grape cuttings as follows:

10340. *Shabash.*

Most widely cultivated of the native sorts in Crimea, nine-tenths of the exported Crimean grapes being of this sort (in 1891). A greenish grape, forming medium-sized to large, firm bunches of large roundish berries. Table sort. (Marked *Madame* on label attached to cuttings.)

10341. *Tchauch.*

Greenish, large berries, often almost like plums. Bunches loose. Rather capricious, being easily affected by rainy or windy weather. Not much exported. Dessert sort.

10342. *Asma.*

Blue black, large, elongated berries in large bunches. Table sort. Not so good as the preceding, but prized for the table because of the contrast between its black bunches and the greenish ones of the other sorts.

10343 and 10344. CORYLUS AVELLANA. **Filbert.**

From Nikita, near Yalta, Crimea. Presented to Mr. E. A. Bessey by Mr. Theophil Kalaida, head gardener of the Imperial Gardens at Nikita. Received January 29, 1904.

10343. *Badem.*

Native near Yalta. Elongated, large nuts.

10344. *Trebizond.*

Native near Trebizond, Asiatic Turkey. Nuts large and round; much grown around Yalta.

10345 to 10348. PYRUS MALUS. **Apple.**

From Nikita, near Yalta, Crimea. Presented to Mr. E. A. Bessey by Mr. Theophil Kalaida, head gardener of the Imperial Gardens at Nikita. Received January 29, 1904.

10345. *Sabla Sinap.*

Distinguished for its beautiful appearance.

10346. *Kandil Sinap.*

Widely grown in the Crimea. Fruit longer than No. 10348. For description of both, see *Revue Horticole*, No. 17, 1890, p. 398.

10347. *Konstantinopel.*

10348. *Sari Sinap.*

The most widely grown and best of the Crimean apples. Very late keeper.

10349 to 10351. Sorbus domestica. **Service tree.**

From Nikita, near Yalta, Crimea. Presented to Mr. E. A. Bessey by Mr. Theophil Kalaida, head gardener of the Imperial Gardens at Nikita. Received January 29, 1904.

10349. *Grossfrüchtige.*

A sort with pear-shaped fruits, $1\frac{1}{4}$ to $1\frac{1}{2}$ inches by 1 to $1\frac{1}{4}$ inches.

10350. *Gewöhnliche.*

A sort with apple-shaped fruits, about 1 inch in diameter. Both this and No. 10349 ripen rather late.

10351.

Seedlings about 18 inches high.

10352. Trifolium johnstoni (?). **Uganda clover.**

From Uganda, East Africa. Received thru Mr. D. G. Fairchild from Mr. R. N. Lyne, Director of Agriculture, Zanzibar, East Africa, January 30, 1904.

"The identification of this species has not been definitely made, but according to a letter of December 29 from Mr. Lyne this is the Uganda clover, which may be of value for breeding experiments in this country. The high plateau of Uganda, upon which this clover grows, altho in the Tropics, has a comparatively mild climate. It is, of course, quite frostless. Mr. Lyne reports nothing further regarding the usefulness of this species, but remarks that Mr. Ainsworth, who secured the seed for him, had great difficulty in collecting it." (*Fairchild.*)

10353. Phaseolus vulgaris. **Bean.**

From Garrettsville, Ohio. Received thru Mr. George J. Streator, February 1, 1904. Grown from S. P. I. No. 3382.

Mr. Streator reports that these beans are far superior to the ordinary white bean, for the reason that they do not spot so badly in wet weather.

10354 to 10363.

From Newton-le-Willows, Lancashire, England. Presented by T. and J. Garton for testing at the experiment stations. Received February 1, 1904.

10354. Avena sativa. **Oat.**

Yellow. (No. 1.)

10355. Avena sativa. **Oat.**

Gray. (No. 2.)

10356. Avena sativa. **Oat.**

Black. (No. 3.)

10357. Avena sativa. **Oat.**

Black. (No. 4.)

10358. Avena sativa. **Oat.**

White. (No. 5.)

10359. Avena sativa. **Oat.**

White. (No. 6.)

10360. Hordeum hexastichum. **Six-row barley.**

(No. 7.)

10361. Hordeum hexastichum. **Six-row barley.**

(No. 8.)

10362. Hordeum distichum. **Two-row barley.**

(No. 9.)

10363. Hordeum distichum. **Two-row barley.**

(No. 10.)

10364. TRITICUM DURUM. **Wheat.**

From Idalia, Colo. Received thru Mr. J. A. Riedesel, February 4, 1904. Grown from S. P. I. No. 9478.

Kubanka macaroni wheat.

10365. CITRUS LIMETTA. **Lime.**

From Seharunpur, India. Presented by Mr. W. Gollan, superintendent of the Government Botanical Gardens, at the request of Rev. N. L. Rockey. Received February 5, 1904, thru Mr. G. N. Collins.

"Fruits at Seharunpur and also at Mussoorie at an altitude of 5,800 feet. A good lime and the hardiest of the Indian sorts." (*Gollan.*)

10366. SECALE CEREALE. **Rye.**

From San Giovanni a Teduccio (near Naples), Italy. Received thru Dammann & Co., February 6, 1904.

Abruzzes.

10367. SECALE CEREALE. **Rye.**

From North Water Gap, Pa. Received thru Mr. M. Luther Michael, February 8, 1904.

Winter Ivanof. Grown in 1903 from S. P. I. No. 1342.

10368 to 10370. PUNICA GRANATUM. **Pomegranate.**

From Chios, Turkey in Asia. Presented by Mr. N. J. Pantelides. Received February 9, 1904.

10371. ELAEAGNUS ANGUSTIFOLIA. **Oleaster.**

From Tiflis, Caucasus. Presented to Mr. E. A. Bessey by Mr. A. Rolloff, director of the Tiflis Botanical Garden. Received February 10, 1904.

Unab-pschat ("date fruit"), a sort with large fruits.

10372. ELAEAGNUS ANGUSTIFOLIA. **Oleaster.**

From Tiflis, Caucasus. Presented to Mr. E. A. Bessey by Mr. A. Rolloff, director of the Tiflis Botanical Garden. Received February 10, 1904.

Matna-pschat ("finger fruit"), a large-fruited sort.

10373 and 10374. TRIFOLIUM ALEXANDRINUM. **Berseem.**

From Cairo, Egypt. Received thru Mr. George P. Foaden, secretary of the Khedivial Agricultural Society, February 10, 1904.

10373. *Muscowi*, or *Misowi*. **10374.** *Saida*, or *Saidi*.

10375. LATHYRUS SATIVUS. **Bitter vetch.**

From Cairo, Egypt. Presented by Mr. George P. Foaden, secretary of the Khedivial Agricultural Society. Received February 10, 1904.

Known in Egypt as *Gilban.*

10376 and 10377. PISTACIA spp.

From Aintab, Turkey in Asia. Received thru Rev. A. Fuller, February 12, 1904.

10376. PISTACIA VERA. **Pistache.**

Mixed varieties of the true pistache.

10377. PISTACIA MUTICA. **Turpentine tree.**

"Obtained from the eastern slope of the Amanus Mountains 60 miles west of Aintab, and 'can be relied on as good.' Trees there are largest and best in the country and climate as dry as could be desired, not being subject to the moisture which affects the western slope of the mountains, because of the nearness to the sea. This variety will take the grafts (buds) of *P. vera.*" (*Fuller.*)

10378. LINUM USITATISSIMUM. **Flax.**

From Salem, Oreg. Received thru Mr. Eugene Bosse, January 28, 1904.

Grown in 1903 from S. P. I. No. 9457.

10379 to 10381. LINUM USITATISSIMUM. **Flax.**

From Vologda, Russia. Procured by Prof. H. L. Bolley from Mr. Pierotraschko, government agronomist. Received January 25, 1904.

From the northern limit for the maturing of flax seed, where the very finest type of Russian fiber is produced.

10382 to 10391. TRITICUM spp. **Wheat.**

From Cairo, Egypt. Presented by Mr. George P. Foaden, secretary of the Khedivial Agricultural Society. Received February 19, 1904.

10392 to 10396. CAPSICUM ANNUUM. **Pepper.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January, 1904.

Seed grown from stock furnished by the Department, as follows:

10392. **Paprika pepper.**

Grown from S. P. I. No. 9475.

10393. **Red pepper.**

Grown from S. P. I. No. 3733.

10394. **Red pepper.**

Grown from S. P. I. No. 7654.

10395. **Red pepper.**

Grown from S. P. I. No. 3977.

10396. **Sweet pepper.**

Grown from S. P. I. No. 3905.

10397. RAPHANUS SATIVUS. **Radish.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January, 1904.

Erfurt Crimson Giant. Grown from S. P. I. No. 9487.

10398. LOTUS TETRAGONOLOBUS. **Winged pea.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January, 1904.

Grown from S. P. I. No. 7700.

10399. RAPHANUS SATIVUS. **Radish.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January, 1904.

Everlasting. Grown from S. P. I. No. 4966.

10400 and 10401. ZEA MAYS. **Sugar corn.**

From Auburn, N. Y. Received thru Mr. G. W. Boynton, February 25, 1904.

Malakhof. Two selections of *Malakhof* corn grown from S. P. I. No. 2799.

10400. First early.

10401. Better quality, but second early.

10402. HORDEUM DISTICHUM NUTANS. **Two-row barley.**

From Kwassitz, Austria. Received thru Aktien-Zuckerfabrik, March 2, 1904.

Original *Hanna* pedigreed brewing barley.

10403 to 10404. GOSSYPIUM ARBOREUM (?). **Tree cotton.**

From Guadalajara, Mexico. Secured by Mr. Edward B. Light, United States consular agent for Señor Hilario Cuevas, of San Luis Soyatlan, Jalisco, Mexico. Received February 10, 1904.

10403. (Light's No. 1.)

"The common variety which grows wild in many parts of the state. It is claimed that the tree resists the effects of the drought when other trees perish. There are no known cultivated cotton trees, but there are native trees which have produced a harvest of 50 pounds of cotton. Neither the light frosts we have, nor the boll weevil, nor any other insects injuriously affect the trees. This is claimed by people who have known the tree for fifty years." (*Light.*)

10404. (Light's No. 2.)

"The finest quality of cotton, and yields more prolifically. It seems that a quarter of a century or more ago the natives used this cotton for making cloth, but none has been made of late years and the trees have never been cultivated by the present generation with that end in view. This tree is readily grown and is very hardy. The tree usually begins to bear when it is from 4 to 5 years old." (*Light.*)

10405. MUSA TEXTILIS. **Manila hemp.**

From Manila, P. I. Presented by Mr. H. T. Edwards, of the Bureau of Agriculture, to Mr. L. H. Dewey. Received February 29, 1904.

Seed collected in Tayanas Province.

10406. VICIA FABA. **Broad bean.**

From London, England. Received thru James Veitch & Sons (Limited), 544 King's road, Chelsea, March 1, 1904.

Veitch's Improved Longpod. This variety should be sown in pots or boxes in a cold frame in January and transplanted early in March, lifting with a good ball and molding up the plants. This is better for early supplies than sowing in the open in autumn. For succession the seed should be sown every three weeks from February 1 until June, on a north border in heavy loam in rows 3 feet apart. To get early pods, topping should take place when a good set of blooms is secured.

10407. PHASEOLUS RADIATUS. **Mung bean.**

From Whittier, Cal. Received thru Mr. C. W. Leffingwell, jr., March 5, 1904. Grown from S. P. I. No. 6430.

10408. (Undetermined.)

From Cochin China. Presented by Mr. J. B. de Taillac, Astoria, Long Island City, N. Y., February 25, 1904.

According to Mr. de Taillac's letter this plant exhales an essence which is so disagreeable to mosquitoes that when placed in windows the insects do not enter the room. This evidence of the efficaciousness of the plant Mr. de Taillac asserts on the information of a friend in Cochin China, where the plant is indigenous.

Mr. de Taillac further remarks that this is also a fodder plant of some value, altho it gives to the milk a slightly disagreeable taste, which can be remedied, however, by the addition to the ration of such a fodder as beets. (See letter of February 3, 1904.)

10409. SWIETENIA MAHAGONI. **Mahogany.**

From Santa Clara, Cuba. Presented by Julio S. Montero & Brothers, March 4, 1904.

Caoba. Seeds of mahogany from the plantation of the father of Montero & Brothers, situated in the province of Santa Clara.

10410. ALEURITES CORDATA. **Wood-oil tree.**

From Hankow, China. Presented by Hon. L. S. Wilcox, consul-general. Received March 3, 1904.

Seed of the wood-oil tree from the province of Hunan, China, fall crop of 1903. According to Consul-General Wilcox's letter of January 12, 1904, "this tree grows wild in the mountains of Szechuan and is also cultivated in the lowlands. The trees, reaching 15 to 20 feet in height, are grown from seed and produce nuts in five or six years. The oil is prest from these seeds, and when they are roasted, before being prest, the oil is more easily extracted. It is better and more is obtained by the latter process. There are several varieties of oil. The yellow or straw-colored one is most exported. The price in this market at present is $5 gold a picul (33⅓ pounds). One variety is black and quite thick and is used entirely by the Chinese. It costs $9 to $10 a picul.

"The name of the oil differs in various localities, as *tung-yu* and *pai-yr*. The value of this oil is due to its astringent and drying qualities. It is used in paints, fine varnishes, and in the manufacture of fine soaps. During the past two years orders from the United States have been constantly increasing, from both the Atlantic and the Pacific coasts. The export is in its infancy but rapidly increasing. The past year 54,475,900 pounds of wood oil were exported from Hankow. This export is annually increasing, the larger portion going to Europe. Seeds can be obtained about the first of the year from orders filled in Hunan and Szechuan. Some have already been sent to the San Joaquin Valley, in California, to a private individual, where they are growing finely, and have led to a request for about 5,000 more seeds from the same party." See also No. 13104.

10411 to 10419. VICIA FABA. **Broad bean.**

From London, England. Received thru William Bull & Sons, Chelsea, S. W., March 3, 1904.

10411. *Bull's Mammoth.*
10412. *Beck's Dwarf Green Gem.*
10413. *Early Longpod.*
10414. *Green Longpod Nonpareil.*
10514. *Monarch Longpod.*
10416. *Seville Longpod.*
10417. *Windsor Improved.*
10418. *Windsor Green Harlington.*
10419. *Johnson's Wonderful Longpod.*

"Broad beans are gross feeders and require a good rich soil and a liberal supply of manure for successful growth. For successional and main crops sow in February, March, and April. The later kinds should be planted in drills 3 inches deep, 4 to 6 inches apart in the rows, the rows to be 2 feet apart. A deep, strong, tenacious soil, liberally manured, is most suitable. Gather for the table when the beans are no larger than full-grown peas, as they become almost uneatable if left to mature, the tegument then being objectionably tough and leathery and the flavor strong. Pick evenly, not young and old together. In England broad beans are subject to black fly, which, if allowed to make headway, will ruin the crop.

"In England the broad bean is one of the best-paying vegetables, and altho it has been successfully grown in America its good qualities have not yet come to be appreciated here. It is worthy of serious consideration." (*Fairchild.*)

10420 to 10435. VICIA FABA. **Broad bean.**

From London, England. Received thru James Carter & Co., March 3, 1904.

10420. *Carter's New Market Garden Windsor.*
10421. *Carter's Improved Windsor.*
10422. *Carter's Seville Giant Longpod.*
10423. *Carter's Mammoth Longpod.*
10424. *Early Mazagan.*
10425. *Early Longpod.*
10426. *Royal Dwarf Fan.*
10427. *Aquadulce.*
10428. *Minster Giant Longpod.*
10429. *Carter's Harlington Green Windsor.*
10430. *Green Windsor.*
10431. *Beck's Dwarf Green Gem.*
10432. *Green Longpod.*
10433. *Carter's Masterpiece Green Longpod.*
10434. *Carter's Leviathan.*
10435. *Carter's Green Leviathan.*

Plant from November to January for earliest, and from February to May for main crop.

10436 and 10437. VICIA FABA. **Broad bean.**

From Boston, England. Received thru W. W. Johnson & Son (Limited), March 3, 1904.

10436. *Johnson's Monster Windsor.*

10437. *Johnson's Mammoth Green Longpod.*

In England these beans are frequently sown in November, being perfectly hardy there. It is customary to plant in double rows, viz, 9 inches apart; that is to say, the two rows in a triangular manner. If when full grown in July they are attacked by black fly, cut off the tops of the plants.

10438 to 10448. VICIA FABA. **Broad bean.**

From Reading, England. Received from Sutton & Sons, March 3, 1904.

10438. *Sutton's Improved Windsor.*

10439. *Sutton's Green Windsor.*

10440. *Beck's Dwarf Green Gem.*

10441. *Green Longpod.*

10442. *Sutton's Giant Windsor.*

Culture for 10438 to 10442.—Sow in February, March, April, and May. Double rows are usual, allowing 9 inches between the two lines forming the row, and from 2 to 3 feet between the rows. The best soil for beans is a deep, strong loam, with plenty of manure.

10443. *Sutton's Green Giant.*

10444. *Sutton's Exhibition Longpod.*

10445. *Sutton's Mammoth Longpod.*

10446. *Improved Minster Longpod.*

10447. *Royal Dwarf Cluster.*

10448. *Early Mazagan.*

Culture for 10443 to 10448.—A sowing may be made in November on light, dry soil, but not until January, February, or March on other soils. Double rows are usual, allowing 9 inches between the two lines for all except Nos. 10447 and 10448, for which allow only 6 inches. The double rows in all cases are from 2 to 3 feet apart. The best soil for beans when sown in the spring is a deep loam, which should be well manured.

10449. ILEX CRENATA. **Holly.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company, January 23, 1904.

"Seed of a hardy evergreen, highly esteemed as a good hedge plant for cold climates." (*H. Suzuki.*)

10450. VOANDZEIA SUBTERRANEA. **Woandzu, or African goober.**

From Camden, Ala. Presented by Dr. L. E. Starr. Received February 17, 1904.

Grown from S. P. I. No. 8915, originally from German East Africa.

10451 to 10453. NICOTIANA TABACUM. **Tobacco.**

From Cuba. Received thru Mr. A. D. Shamel, of this Department, March 10, 1904.

10451.

From plantation of Señor Govino Menéndez, near San Juan y Martinez, in the Vuelta Abajo district. (Shamel's No. 1.)

10452. *Cuban.*

From plantation of Señor Galixto López, near San Luis. (Shamel's No. 2.)

10453. *Cuban.*

From plantation of Señor Justinio Sanchez, in Vuelta Abajo district, near Pinar del Rio. (Shamel's No. 3.)

10454. TRITICUM DURUM. **Macaroni wheat.**

From Blackfoot, Idaho. Received thru Prof. H. T. French, director of the Idaho Agricultural Experiment Station, March 9, 1904.

Kubanka macaroni wheat grown from S. P. I. No. 9478.

10455. AVENA SATIVA. **Oat.**

From Blackfoot, Idaho. Received thru Prof. H. T. French, director of the Idaho Agricultural Experiment Station, March 9, 1904.

Swedish Select oat grown from S. P. I. No. 9422.

10456. PHLEUM PRATENSE. **Timothy.**

From Copenhagen, Denmark. Presented by the Botanic Gardens of Copenhagen, thru Prof. Dr. Warming. Received March 8, 1904.

For breeding purposes.

10457. AMYGDALUS PERSICA. **Peach.**

From Bassorah, Arabia. Presented by Haji Abdulla el Nejem, of Bassorah. Received March 8, 1904.

Seeds of various varieties of peaches which are grown in the region of Abdul Khasseb, the great date-growing center of Arabia. These peaches are subjected to the extreme hot weather of this portion of Arabia and are likely to be of interest for breeding purposes in California and Arizona.

10458 to 10461. PHLEUM PRATENSE. **Timothy.**

From Austria-Hungary. Presented by Prof. Emanuel Gross, of the Agricultural Academy, Tetschen-Liebwerd. Received March 9, 1904.

10462. COCHLEARIA ARMORACIA. **Horse-radish.**

From Grand Island, Nebr. Received thru Mr. E. Corbin, March 14, 1904.

Malin. Grown from S. P. I. No. 5761.

10463. CALOPHYLLUM INOPHYLLUM.

From Honolulu, Hawaii. Received thru Mr. J. G. Smith, in charge of the Agricultural Experiment Station, March 12, 1904.

Seed of this tropical tree, related to the mangosteen, for Mr. Oliver's experiments in grafting.

10464. PSIDIUM sp. **Guayabillo.**

From Iguala, Guerrero, Mexico. Presented by Mr. Federico Chisolm, Arcelia. Received January 11, 1904.

10465 to 10472.

From Arcelia, Guerrero, Mexico. Presented by Mr. Federico Chisolm. Received March 12, 1904.

Native Mexican bulbs and seeds, for the most part unidentified.

10473. SOLANUM JAMESII. **Potato.**

From Moab, Utah. Received thru Mr. E. Corbin, of Grand Island, Nebr., March 14, 1904.

Wild or *Cave Dwellers'* potatoes. "I obtained these potatoes last October, when on a visit to southeastern Utah, at Moab, a town about 40 miles south of the Denver and Rio Grande Railway, leaving the railway at Thompson Springs. It is a small town near the mouth of the Grand River where it joins the Green River. Some, found where the ground was soft, were larger than others. It will be seen that there are two kinds. They have run all over the ground where it is not cultivated. They live in the ground frozen hard all winter. They have a top and leaf resembling tomato." (*Corbin.*)

10474. Triticum monococcum. **Einkorn.**

From Erfurt, Germany. Received thru Haage & Schmidt, March 14, 1904.

10475 to 10521.

From Sydney, New South Wales, Australia. Presented by Mr. J. H. Maiden, superintendent of the Sydney Botanical Gardens. Received March 1, 1904.

A collection of small packets of seed of native plants, as follows:

10475. Acacia aneura.

"Mulga" or "Yarren." A tall shrubby plant or small tree, never attaining a much greater height than 20 feet. Affords an unfailing supply of good forage during long and severe droughts. Drought-enduring qualities are remarkable. Wood is excessively hard and valuable for timber. Considered worthy of cultivation. Western Australia thru mainland colonies to Queensland. Peculiar to the arid western plains beyond the Darling River. (Reference: *Forage Plants of Australia*, p. 33.)

10476. Acacia montana.

A tall shrub, widely distributed in mountain and forest regions, rocky hills, etc., in the southwestern part of New South Wales.

10477. Acacia neriifolia.

A tall shrub. New South Wales, dividing range to table-lands from Clyde River to Queensland; open forests on Balonne River.

10478. Alchornea ilicifolia.

A tall shrub. New South Wales, brush forests; Queensland.

10479. Alpinia caerulea.

An erect perennial herb, 3 to 5 feet, with a terminal inflorescence. New South Wales; coast district in brush forests from Hunter River to Queensland.

10480. Barringtonia alba.

Molucca Islands. "The majestic habit of the tree, the splendor of the foliage, the magnificence of the flowers, and, finally, the singular form of the fruit, will attract the attention of the most indifferent." (Extract from *Flore des Serres*, vol. 7, genus description.)

10481. Blandfordia flammea.

Tender, bulbous plant with large, showy, red flowers in short racemes. Eastern Australia, in peat bogs and on shady mountain sides.

10482. Blennodia lasiocarpa.

"Hairy podded cress." Annual, 1 to 1½ feet high, covered with pubescence; pod hairy. Peculiar to the Darling River, sandy plains near the Murray River, and generally over the arid plains of Australia. Makes its growth during the hottest part of the year; valuable for forage. (Reference: *Forage Plants of Australia*, p. 4.)

10483. Brunonia australis.

Herbaceous plant with capitate blue flowers. New South Wales; in dry pastures, chiefly in the west; also in other colonies.

10484. Cassinia theodorei.

A heath-like shrub; branches and under side of leaves woolly white. New South Wales, head of Gwydir River.

10485. Capparis mitchellii.

"Native orange." A small tree. Fruit from 1 to 2 inches in diameter; eaten by natives. Wood hard, whitish, close grained, suitable for carving, engraving, and similar purposes. All colonies except Tasmania and Western Australia.

10475 to 10521—Continued.

10486. Castanospora alphandi.

Large tree with pinnate leaves; flowers racemose-paniculate.

10487. Celtis paniculata.

Tree 25 to 35 feet high; wood soft, white, pliable; used for hoops for casks. New South Wales, Queensland, and northern Australia; not endemic in Australia.

10488. Chloris truncata.

"Windmill grass," or "star grass." An erect grass, perennial and showy. Valuable as a forage plant; an excellent summer and autumn grass. In all Australian colonies except Tasmania and Western Australia.

10489. Combretum loeflingii.

Climbing or diffuse shrub. Tropical South America.

10490. Craspedia richea.

A rather large perennial. New South Wales, thruout the colony in grass land; also in Victoria, Tasmania, South Australia, and Western Australia.

10491. Dianella tasmanica.

Perennial fibrous-rooted plant with grasslike leaves 2 to 4 feet long; large, loose panicles of blue flowers on delicate pendent pedicels. Succeeds best in open border of a cool greenhouse. Tasmania and Australia; common in rich, moist soil.

10492. Dillwynia cinerascens.

Pretty yellow-flowered juniper-leaved shrub. New South Wales; also coast district and dividing range from Hunter River to Victoria; Tasmania. Common in grassy places.

10493. Dodonaea triquetra.

"Hop bush." A shrub. Victoria, New South Wales, Queensland.

10494. Dysoxylon muelleri.

"Pencil cedar" or "turnip wood." Tree with compound leaves; timber of a rich, red color; used for cabinetmaking and window work. Northern New South Wales and Queensland.

10495. Elaeodendron curtipendulum.

Probably a tree or shrub. Norfolk Island.

10496. Eremophila brownii.

Very variable shrub, often tall. Victoria, Murray desert; New South Wales, western plains; South Australia.

10497. Eremophila latifolia.

Small spreading shrub. New South Wales, southern interior; Western and South Australia.

10498. Eremophila maculata.

Tall shrub with rigid branches. Western and South Australia; western plains of New South Wales and Queensland; Victoria.

10499. Eremophila mitchelli.

Shrub or small tree, on elevated stony lands. New South Wales, western plains in the south.

10500. Eremophila oppositifolia.

"Emu bush." Ornamental shrub or small tree, sometimes attaining a height of 20 feet; more or less hoary; leaves 1 to 2 inches in length; flowers about 1 inch long. Grows in the most arid parts of the continent and is available for forage. "Will grow when not a blade of grass is seen for weeks together." Worthy of cultivation. Plains between Lachlan and Darling rivers in New South Wales; near Murray River in Victoria, and in the interior of South Australia.

10475 to 10521—Continued.

10501. Eremophila bowmani.

Erect shrub. Western plains from Byrock to Queensland.

10502. Eriostemon difformis.

Small bushy shrub. Interior of New South Wales.

10503. Eucalyptus behriana.

A small shrub or small tree. Near sources of Werribee River, on stony hills; in hill forest region of Wirrabara, near Crystal Brook and Mount. Remarkable on deep, nearly clay soil.

10504. Eucalyptus diversicolor.

"Karri," "Blue gum." Colossal tree, exceptionally reaching a height of 400 feet. Furnishes good timber for building. Southwestern Australia, in fertile, rather humid, valleys; on small elevations in swamps near rivers beyond the reach of water.

10505. Eucalyptus coccifera.

Small tree with leaves under 3 inches long. Tasmania, 3,000 to 4,000 feet elevation. Possibly a subalpine form of *E. amygdalina.*

10506. Eucalyptus incrassata.

Shrubby or arborescent, exceptionally rising to 30 feet. From the Murray and Darling rivers thru desert tracts to the Great Bight. Chiefly on sand ridges, but also on Tertiary limestone, extending in some places to the brink of the ocean.

10507. Eucalyptus tereticornis.

"Flooded gum tree." Tall tree when well developed, but seldom exceeding 100 feet. Timber is excellent. Never very far removed from littoral regions; occupying generally humid flats or growing around swamps and lakes or along water courses, never on saline ground or salt-water streams.

10508. Eucalyptus virgata.

A tall, straight-growing white gum. Valleys of the higher parts of the Blue Mountains or at the foot of cliffs in fairly good soil.

10509. Hovea heterophylla.

A blue-flowered, evergreen shrub, prostrate or decumbent. New South Wales, coast district to table-land in dry, stony localities.

10510. Melaleuca pustulata.

Small or tall shrub. New South Wales, southern interior; Victoria, Tasmania, South Australia.

10511. Myoporum deserti.

"Sweet-fruited myoporum." Erect shrub, 3 to 4 feet high, with linear leaves 1 to 2 inches long. Said by some to be poisonous when in fruit; others state that it is a capital forage plant. Found principally in the interior of all the colonies of Australia. (See *Forage Plants of Australia*, p. 40.)

10512. Olearia pimeloides.

Bushy shrub. Victoria and western plains of New South Wales.

10513. Podolepis acuminata.

Erect perennial shrub. New South Wales; Victoria, Hardinger range at elevations of 5,000 feet; Tasmania, abundant in many parts of the colony, ascending to 4,000 feet.

10514. Prostanthera striatifolia.

Rather small, rigid shrub. New South Wales, barren hills of the interior from Lachlen River to Queensland.

10515. Grevillea linearis.

A tall, delicate shrub, with spreading branches and linear leaves. New South Wales, coast district and dividing range from Clyde River to Port Jackson.

10475 to 10521—Continued.

10516. SPOROBOLUS LINDLEYI.

A slender-growing perennial grass. Grows on rich soil and is much relished by all kinds of stock. All Australian colonies except Tasmania.

10517. SCLEROLAENA BICORNIS.

"Cotton bush." Small, stout shrub, densely white, tomentose. New South Wales, western plains.

10518. TRICHINIUM ALOPECUROIDEUM.

Rather slender, perennial herb. New South Wales, western plains; also in other Australian colonies.

10519. TRICHINIUM OBOVATUM.

"Silver bush." An erect undershrub 1½ to 4 feet. Flower spikes globular. Has remarkable drought-enduring qualities; will grow in the driest of soils when once fairly established. Valuable as a forage plant. Arid interior of all Australian colonies.

10520. TRICHINIUM EXALTATUM.

Tender perennial, 2 to 3 feet. Western plains of New South Wales; other Australian colonies.

10521. TRICHINIUM NOBILE.

"Yellow-hairy spikes." Stout perennial herb. Not easily affected by drought; affords a rich, succulent herbage even in very dry weather, of which stock are very fond. Interior of New South Wales and South Australia and Victoria. (Reference: *Forage Plants of Australia*, p. 85.)

10522. GARCINIA MORELLA. **Gamboge.**

From Kingston, Jamaica. Presented by Dr. William Fawcett, director of the Botanical Garden. Received March 17, 1904.

"A moderate-sized tree which produces the true gamboge of commerce, used in Europe and America as a pigment. In the Orient this pigment is used for dyeing silks and other fabrics. The oil in the seeds is used in Mysore as a substitute for lamp oil. These seeds are imported for use as a stock for the mangosteen, upon which the latter was grown successfully many years ago by Mr. Harris, superintendent of Castleton Garden, Jamaica, and also later by Mr. Hart, of Trinidad. Fruit the size of a cherry, subglobose, slightly four-lobed, four-celled, and four-seeded. In Singapore this species grows without any particular attention, it is said, and attains a height of 35 to 50 feet. It is probable that this species has a much more vigorous root system than the mangosteen, and is therefore a promising possibility as a stock for the mangosteen." (*Fairchild.*)

10523. PHASEOLUS ANGULARIS. **Bean.**

From Kingston, R. I. Presented by Mr. G. E. Adams, of the Rhode Island Agricultural Experiment Station. Received March 12, 1904.

A bean secured by Professor Brooks, of the Massachusetts Agricultural Experiment Station, in Japan, under the name of "*White-Podded Adzuki* soy bean."

10524. MISCANTHUS CONDENSATUS (?).

From Yokohama, Japan. Presented by Mr. H. Suzuki, of the Yokohama Nursery Company. Received March 9, 1904.

"This root having been brought from the southeastern part of Japan, where there is no snow in winter, it is doubtful whether it will stand your climate. It will therefore be well to try it in such Southern States as Florida or California. I am sure it will succeed well. In the native region where these plants are growing its leaves remain green all thru the year and cattle are fed upon it. It should be cut while young, before its full growth, as the stem gets too hard if left too long. Young stems can be cut gradually from time to time thruout nearly the whole year, but a few stems on each clump should always be left without cutting, as it sometimes dies out if cut off too severely. I endeavored to get some seed of this plant, but the stems being constantly cut by the villagers make it very difficult to secure them. It seldom flowers. The roots, however, can be secured in any quantity." (*Suzuki.*)

10525. PYRUS MALUS. **Apple.**

From Amassia, Turkey. Presented by Mr. H. Caramanian. Received March 16, 1904.

Misket. A variety of apple from this noted fruit region of Turkey. In letter of April 25, Mr. Caramanian remarks "that the Misket apple is the best variety of apple grown in this country. It has a crimson-red color when fully ripe. Its texture is fine and its flavor deliciously sweet. It has a keen, musky smell peculiar to itself, from which it takes its name, *misk* in Arabic meaning musk. In a room containing only one apple one may discover its presence by its smell. In exceptional cases individual specimens weigh as much as a pound, but are generally smaller. In such a town (Amassia), where a hundredweight of peaches costs from 20 to 25 cents, this apple is sometimes sold as high as 15 cents a pound. First-class apples are exported to Constantinople and the rest are used here."

10526. PRUNUS DOMESTICA. **Plum.**

From Amassia, Turkey. Presented by Mr. H. Caramanian. Received March 16, 1904.

Uryäný. A variety of plum from this noted fruit region of Turkey. In a letter of April 25, Mr. Caramanian says: "The Uryäný plum is one of the choicest varieties of plums that I have ever seen here or in America. It is of a greenish yellow color when fully ripe. It is very fleshy and juicy, with an exceedingly thin skin. It tastes sweet and the stone is not very loose. As the orchardists do not know how to take care of the fruit trees, we find only a few perfect specimens on the trees."

10527. PHASEOLUS RADIATUS. **Mung bean.**

From Patras, Greece. Received thru Mr. Socrates Xanthopoulo, March 17, 1904.

10528 to 10530. ALNUS spp.

From Yokohama, Japan. Presented by Mr. H. Suzuki, of the Yokohama Nursery Company. Received March 9, 1904.

10528. ALNUS JAPONICA (?).

10529. ALNUS FIRMA.

10530. ALNUS INCANA.

"Species of Alnus which are used by the Japanese as shade or shelter trees in the plantations of the Mitsumata paper plants, especially on hillside plantations. From the fact that the different species of Alnus produce root tubercles it is hoped that cultures can be secured of the micro-organisms which form them. It has been suggested by Mr. Swingle that the value of this Alnus as a shelter plant may be due largely to the nitrogen-collecting power of these tubercles. If this proves to be true, the cultivation of these species of Alnus may be of value for certain American cultures and especially in connection with the cultivation of the paper plant." (*Fairchild.*)

10531. BETA CICLA. **Leaf beet.**

From Vomero, near Naples, Italy. Presented by Dr. Carl Sprenger, March 18, 1904.

Seeds for experiments in breeding with the sugar beet, to be carried on by Dr. C. O. Townsend and Mr. E. C. Rittue.

10532. TRIFOLIUM PRATENSE. **Red clover.**

From Riga, Russia. Secured by Mr. E. A. Bessey from Mr. Heinrich Goegginger. Received March 21, 1904.

Orel.—The seed of the promising hairless clover No. 16, to which it is desired to call special attention, was obtained by Mr. Bessey through Mr. Goegginger, of Riga, and was produced on the estate of a German grower near Yeletz, in the eastern part of the Orel government. The grower made a practise of saving his own seed, and hence this strain had been grown on the same estate for a number of years.

According to Mr. Goegginger, the government of Orel furnishes the best red clover seed obtainable in Russia. Its chief crops are winter rye and oats, and it is in rotation with these that the clover is grown. A small quantity of winter wheat is also grown.

This variety is distinguished by the dustlessness of its hay, due to almost complete absence of hairiness from all parts of the plant; by its heavy yields for the first crop; by its leafiness and the persistence of the basal leaves; by the succulence of the stems, which improves greatly the quality of the hay and reduces the waste due to woody, uneatable portions; by greater palatability than hay from domestic seed, and by the fact that it comes to proper maturity for harvesting from ten days to two weeks later than the ordinary American red clover.

Except in certain sections and for certain purposes this variety is not recommended for supplanting domestic red clover, but rather for supplementing the latter. See Bulletin No. 95 of the Bureau of Plant Industry entitled "A New Type of Red Clover." (*Charles J. Brand.*)

10533 and 10534. Trifolium pratense. **Red clover.**

From Riga, Russia. Secured by Mr. E. A. Bessey from Mr. Fr. Lassmann, Riga, Russia. Received March 21, 1904.

10533.

From estate owned by Mr. Legsdin, Mohileff government, near Zhlobin.

10534. *Courland.*

From estate of Mr. Sillin, Neuhof, Courland government. A high-growing sort.

10535 to 10543. Vicia faba. **Broad bean.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., March 21, 1904.

10535. Large, common field variety.

10536. *Perfection.*

10537. *Sevilla*, long-podded.

10538. *Aguadulce*, extra long-podded.

10539. *Windsor.*

10540. *Green Windsor*, or *Genoa.*

10541. *Small Green Julienne.*

10542. *Dwarf Early.*

10543. *Beck's Gem*, green.

10544. **Bean.**

Originally from Spain. Received thru Mr. Rosendo Torras, of Brunswick, Ga., March 20, 1904.

Large white beans, slightly marked with red, varying in size. "Apparently different from any raised in this country." (*Torras.*)

10545. Phleum pratense. **Timothy.**

From Vienna, Austria. Received thru Dr. Victor Lieb, Court Gardener to Palace of Miramar, near Trieste, Austria, March 24, 1904.

10546. Phleum pratense. **Timothy.**

From Luleå, Sweden. Received thru Dr. Paul Hellström, March 24, 1904.

Grown at Persön Norrbattens Läu, Sweden, in 1901. Imported for the experiments in the breeding of timothy at Ithaca, N. Y.

10547 to 10550. Phleum spp.

From Vienna, Austria. Received thru Doctor Weinzierl, Councilor, Seed Control Station in Vienna, March 24, 1904.

Four species of Phleum from the experiment station in the Austrian Alps, known as the Sandling-Alp Station, which has won a wide reputation for its work on forage crops and grasses in the Alps. These seeds were imported for breeding purposes, especially at the Cornell Experiment Station at Ithaca, N. Y.

10547. PHLEUM MEDIUM.

10548. PHLEUM ALPINUM.

10549. PHLEUM MICHELLII.

10550. PHLEUM PRATENSE.

10551. (Undetermined.)

From Arcelia, Guerrero, Mexico. Presented by Mr. Federico Chisolm. Received March 26, 1904.

Seeds of a "blue-flowered perennial 12 to 18 inches high. Flowers 1¼ inches in diameter with yellow center. Ought to be used for bedding." (*Chisolm.*)

10552. TRITICUM VULGARE. **Wheat.**

From Sitka, Alaska. Grown at the Alaska Agricultural Experiment Station by Prof. C. C. Georgeson, from S. P. I. No. 1341 (?). Presented to the Secretary of Agriculture (probably in 1900) by Professor Georgeson.

10553 to 10556. CUCUMIS MELO. **Muskmelon.**

From Khojend, Russian Central Asia. Presented by Mr. E. Valneff to Mr. E. A. Bessey. Received March 28, 1904.

10553. *Ak Kuiriuk.*

10554. *Bosvaldi.*

10555. *Parsildak.*

10556. *Savnazik.*

10557. BLIGHIA SAPIDA. **Akee.**

From Hog Island, near Nassau, West Indies. Presented by Mrs. Ralph Johnson. Received March 25, 1904.

"The fruit of the akee, especially the arillus lying immediately below the seeds, is reported to be a delicious vegetable and to resemble in taste bits of sweetbread when cooked with meats or omelets. Worthy of attention in the Subtropical Gardens in Florida and a possibility as a culture in Porto Rico." (*Fairchild.*)

10558 to 10562. AMYGDALUS COMMUNIS. **Almond.**

Received thru Mr. J. W. Kerr, of Denton, Md., April 7, 1904

10558. *Castillet.*

Grown from S. P. I. No. 7133 (745).

10559. *Fabrica.*

Grown from S. P. I. No. 7135 (748).

10560. *Jordan.*

Grown from S. P. I. No. 7398 or No. 7401 (765 and 771).

10561. *Mollar.*

Grown from S. P. I. No. 7061 (740).

10562. *Planeta.*

Grown from S. P. I. No. 7062 or No. 7134 (741 and 746).

10563. TRIFOLIUM PRATENSE. **Red clover.**

From St. Petersburg, Russia. Secured by Mr. E. A. Bessey from Mr. G. Frick. Received April 11, 1904.

"Seed from Rjeschiza, Vitebsk government, in northwestern Russia. Should prove hardy." (*Bessey.*)

10564. TRIFOLIUM PRATENSE. **Red clover.**

From St. Petersburg, Russia. Secured by Mr. E. A. Bessey from Mr. G. Frick. Received April 11, 1904.

"Seed from Ekaterinburg, in Siberia. Climate very cold in winter." (*Bessey.*)

10565 to 10567. TRIFOLIUM spp. **Clover.**

From Russia. Presented by Prof. Charles E. Bessey, of the University of Nebraska. Received April 9, 1904.

Samples of clover seed collected by Professor Bessey in the summer of 1903, as follows:

10565. TRIFOLIUM LUPINASTER. **Five-leaf clover.**

10566. TRIFOLIUM sp.

10567. TRIFOLIUM HYBRIDUM. **Alsike.**

"Last summer I picked up several seeds of odd clovers which interested me very much, and I am wondering whether you may not wish to have them. One of these seeds is the five-foliate clover, which was given me by the professor in the Agricultural Institute of Moscow. Another resembles the common red clover, but is evidently distinguished from that species. I collected these seeds in the heart of the Caucasus Mountains, at an altitude of probably 6,000 feet. The exact locality is Kazbek. Another resembles the alsike clover and was obtained from the same locality as the last." (*Bessey.*)

10568. CYPERUS PAPYRUS. **Egyptian paper plant.**

From Washington, D. C. Presented by Mr. Peter Bisset, gardener of the Gardner Hubbard estate, "Twin Oaks," Washington, D. C. Received March 30, 1904.

10569. FAGOPYRUM ESCULENTUM. **Buckwheat.**

From Walhonding, Ohio. Presented by the originator, Mr. Charles L. Lonsinger, thru Hon. J. W. Cassingham, M. C. Received April 1, 1904.

The variety is described by Mr. Lonsinger, in his letter of February 23, 1904, to Mr. Cassingham, as follows:

"It is a variety of my own creation and it withstands hot weather better than any other variety. To determine this, I have been sowing it to have it filling during heat of summer. In this I had an excellent test the summer of 1901, when it filled while the thermometer registered 95° to 102° F. in the shade day after day. My motive was to get a heat-resisting variety, in which I am pleased with my success. What I claim for it is that it will produce plump grains in hot weather, when other varieties fail and the Japanese varieties shrivel beside it; that it will produce more per acre than Silverhull or Japanese buckwheat, and will double the yield of either in hot weather. It can be sown in spring and midsummer, or in ordinary seasons two crops can be grown.

"It grows a stout plant and stands up better than Silverhull. In a test with Silverhull, 2 bushels each by weight, it produced one-half pound more flour than Silverhull and cakes were of a milder flavor than cakes from Silverhull. Six pounds in chaff (5 pounds, estimated, clean seed), selected in 1902, and sown in spring of 1903 on ordinary ground and shaded on one side by timber, produced 454 pounds, or 9 bushels 4 pounds. In 1902 I sowed it July 5 and it was ripe September 10."

10570. SOLANUM TUBEROSUM. **Potato.**

From New York, N. Y. Presented by J. M. Thorburn & Co., seedsmen.

Earliest of All, a new seedling variety.

10571 to 10575.

From Arcelia, Guerrero, Mexico. Presented by Mr. Federico Chisolm. Received March 28, 1904.

A collection of bulbs and tubers, mostly unidentified.

10576. COCHLEARIA ARMORACIA. **Horse-radish.**

From Edgewater Park, N. J. Presented by Mr. B. D. Shedaker. Received April 13, 1904.

Maliner Kren. Roots grown from S. P. I. No. 5761.

10577. TRIFOLIUM PRATENSE. **Red clover.**

From Riga, Russia. Secured by Mr. E. A. Bessey from Mr. H. Goegginger. Received April 15, 1904.

"Red clover from Ufa, a dry region and cold in winter but having little snow. Seed rather poor, but for climatic regions ought to be valuable." (*Bessey.*)

10578. PHLEUM PRATENSE. **Timothy.**

From Tokyo, Japan. Presented by Dr. Oscar Loew, of Komaha Agricultural Experiment Station. Received April 13, 1904.

"Sample of seed for Mr. Gilmore's experiments in the selection of better races of timothy at the State Agricultural Experiment Station, Ithaca, N. Y. Furnished Doctor Loew by the Tokyo Plant Seed Company. The origin of the seed is uncertain. Presumably, however, it was gathered in Japan." (*Fairchild.*)

10579. EUTREMA HEDERAEFOLIA. **Dry-land wasabi.**

From Yokohama, Japan. Presented by Mr. H. Suzuki, of the Yokohama Nursery Company. Received April 18, 1904.

"This wasabi is said to grow well in ordinary dry soil in shade, but it being a native of the central part of Japan it might not resist your climate.

"It seems to be much easier of cultivation than the ordinary wasabi which we sent you before, tho it will take some years before it grows to the size of ordinary wasabi roots, but, as the leaves have a very good flavor, it is said to be eaten by the natives as one of the best kinds of spice. It is mostly growing wild and not in cultivation yet." (*Suzuki.*)

10580 to 10582. PRUNUS CERASUS. **Cherry.**

From Moscow, Russia. Secured by Mr. E. A. Bessey, thru Mr. Emil Meyer, head gardener of the Agricultural Institute. Received April 18, 1904.

10580. *Vladimir.*

10581. *Roditelsky.*

10582. *Vladimir.*

10583 to 10586. **Barley.**

From Svalöf, Sweden. Received thru the Allmänna Svenska Utsädesaktiebolaget (General Swedish Seed-Breeding Company), April 18, 1904.

"A collection of pedigreed brewing barleys, each one 100 per cent pure seed, which have been produced by selection at the Swedish Seed-Breeding Institute in Svalöf, under the direction of Dr. N. H. Nilsson. They are recommended for their remarkable uniformity of growth, their heavy yielding character, and the low nitrogen content of their kernels. Belonging to the two-rowed type of barley, they require to be kept longer on the growing floor or in the growing drum of the malt house, but in the opinion of European experts these pedigreed pure races of barley grow more uniformly and make a better quality of beer than the ordinary types of barley grown in America, which are all of mixed races. The different sorts represent practically pure types of Doctor Nilsson's various barley races and translations of his descriptions are given herewith." (*Fairchild.*)

10583. HORDEUM DISTICHUM NUTANS.

Prinsess. 0105. Head relatively thick and broad, with somewhat separated kernels and spreading awns. Before ripening, yellowish. Kernel finely built, medium in size, full, on both sides unusually finely wrinkled, yellow, with a slightly whitish tint. Plant strong, of medium height, thickly leaved, very well stooled, with strong, relatively stiff stems; leaves somewhat high on the stem. Medium late, ripening a few days later than the *Chevalier.* Extraordinarily productive, especially suited for mild, moderately strong, not too heavy soils. As a brewing barley, especially high prized. Belonging to Doctor Nilsson's Alpha group

10584. HORDEUM DISTICHUM NUTANS.

Chevalier II. 0402. Head long, small, and loose, with kernels not divergent; never reddish colored. Kernel medium sized, full, and especially finely

10583 to 10586—Continued.

formed, finely wrinkled, and strongly yellow colored. Plant medium strong; leaves abundant, but placed low on the plants. Not very abundantly stooled, with somewhat weak culms. On account of this latter habit a variety especially suited to warm, light, not very heavy soils. Productivity, medium. Ripening time, not very early, but still a few days before the *Prinsess*. As a brewing sort, in suitable locations, much esteemed. Belonging to Doctor Nilsson's Alpha group.

10585. HORDEUM DISTICHUM NUTANS.

Hannchen. Head unusually thick for nodding barley; kernels not divergent and therefore the head is more compact, narrower, small, standing horizontally on the straight culm; light yellow in color before ripening. The awns are often thrown off. Kernel small, especially fine in form and color; light yellow, very finely wrinkled. Plant of peculiar habit, late starting into growth, but nevertheless very heavily stooling with several equally strong, graceful, but hard and very stiff culms which have few leaves, and these are near the ground. Ripens very early, little later than the *Swansneck*. Productiveness very good. Especially adapted for light, warm soils, and above all for high altitudes. Can stand well heavy manuring. As a brewing barley well qualified. It belongs to Doctor Nilsson's Alpha group.

10586. HORDEUM DISTICHUM ERECTUM.

Primus. 0706. Head rather long and relatively small, somewhat loosely built, with awns slightly spreading. Head borne on the culm, which is bent above almost horizontally. Kernel good, medium large, especially finely formed and full, finely wrinkled, rich yellow. Plant strong, moderately stooled, with upright very strong culms. Ripens early, scarcely perceptibly later in maturing (a day or so) than the *Hannchen*. Productiveness especially good. Quite certainly, so far as quality is concerned, the highest grade yet known among the "Imperial" barleys. Especially suited to heavy, cold loams and clay soils, such as are to be found in middle Sweden. Bred in the region where the sort already—thanks to its strong culms and earliness—has opened quite new regions for the culture of brewing barley.

10587. JUGLANS hyb. **Walnut.**

From Santa Ana, Cal. Received thru Mr. P. H. Dorsett, of Chico, Cal., April 18, 1904.

"I am sending you a tree which, as near as can at this time be determined, is a hybrid between the southern California black walnut and the native live oak. Native black-walnut seeds were planted as stocks, and these trees appeared in the rows. Walnut buds 'take' on these as readily as on the native stock, or even more readily." (*Dorsett.*)

10588. LOLIUM PERENNE. **Rye-grass.**

From The Hague, Holland. Presented by Mr. Berendsen, hortulanus of the Royal Zoological-Botanical Society. Received April 17, 1904.

Westerwoldicum. "A variety of rye-grass originated in the north of Holland, which has the reputation of being much superior in rapidity of growth and quantity of hay cut to that grown from the Scotch variety, which is sometimes planted here." (*Berendsen.*)

10589. PHLEUM PRATENSE. **Timothy.**

From The Hague, Holland. Presented by Mr. Berendsen, hortulanus of the Royal Zoological-Botanical Society. Received April 17, 1904.

"According to Mr. Berendsen the timothy seed used in Holland is usually imported from Scotland. This may be of Scotch origin. Imported for the timothy experiments conducted at the Cornell University Agricultural Experiment Station, Ithaca, N. Y." (*Fairchild.*)

10590 to 10597. DIOSCOREA spp. and XANTHOSOMA spp. **Yam and yautia.**

From San Juan, P. R. Presented by Miss Jenny H. Ericson. Received April 19, 1904.

A collection of Porto Rico yams and yautias not identified botanically. Yam culture in the West Indies is one of the most profitable small-plant industries. The botanical nomenclature of the various species is an important question.

10598 to 10614.

From Askhabad, Trans-Caspian territory, Turkestan. Secured by E. A. Bessey from Mr. A. Bashmakoff. Received April 22, 1904.

A collection of seeds and cuttings as follows:

10598 to 10609. VITIS VINIFERA. **Grape.**

10598. *Kara Kischmisch*, *Shiburgani*, or *Black Kishmish.*

Berry elongated oval, violet black, seedless, small, very sweet, producing a good red wine and also best *Black Kishmish* raisins; ripens in August.

10599. *Hussein Kara*, or *Black Huseïni.*

Differs from No. 10604 in its black color; ripens in July.

10600. *Halili ak*, or *White Khalili.*

Berry oval, conical, small, green covered with black dots, hard, of average taste; one of the earliest Asiatic sorts; ripens about the middle of June.

10601. *Daria.*

Berry spherical, or sometimes slightly elongated. Dark carmine with yellowish spots, sweet; a very early sort; ripens at Bairam Ali about the middle of June.

10602. *Bagishty.*

Berry large, spherical, very sweet, golden when ripe. This sort is good for table use and for jelly, etc.; is also a wine variety; ripens early in September.

10603. *Taifi.*

Berry elongated oval, obtuse at the apex, greenish color covered with dark carmine streaks and bloom, sweet; flesh very compact; when hung from the ceiling of a cool room it keeps the whole winter; has no superior for preserves and marmalade; ripens the middle of September.

10604. *Husseini ak*, or *White Huseïni.*

Berry white, at the time of ripening wax-colored, long, very sweet and juicy; the best table sort; ripens in June and July. (See No. 10290.)

10605. *Sahibi rosa*, or *Rosa Sakhabi.* (See No. 10305.)

10606. *Schokar ak*, or *White Shokar.*

10607. *Schiburchani*, or *Shiburkhani.*

10608. *Wassarga*, or *Vasarga.*

Berry large, comprest, spherical, with one or two furrows at the stalk, at maturity golden color, giving a good table wine; also good for making raisins.

10609. *Maska.*

Berry white, spherical, sometimes elongated, very large, reaching the size of a plum; used for the preparation of the best sorts of raisins; also for preserves; one of the most showy of the Central Asiatic sorts; ripens in July.

10610. PHASEOLUS RADIATUS. **Mung bean.**

Masch.

10598 to 10614—Continued.

10611. TRITICUM POLONICUM (?). **Wheat.**

Red Winter; unirrigated.

10612. ANDROPOGON SORGHUM (?). **Sorghum.**

Djugara.

10613. CHAETOCHLOA ITALICA. **Millet.**

Kunach, or *Kunak.*

10614. KOSTELETZKYA PENTACARPA.

Kanaf.

10615 to 10620. PERSEA GRATISSIMA. **Avocado.**

From Honolulu, Hawaii. Presented by Mr. Donald MacIntyre, Moanalua Gardens, Honolulu. Received April 22, 1904.

10615. *Large Purple.*

Flesh thick, of good, nutty flavor, yellow, and fiberless; seed comparatively small, about one-fourth of fruit; crop medium; pear-shaped; length and diameter over standard (4 by 6 inches). (No. 1.)

10616. *Small Green.*

Flesh not thick and with no nutty flavor, but quite fiberless and rather sweetish; fruit roundish, length in diameter about 4½ inches; late, heavy bearer, constant cropper. (No. 4.)

10617. *Large Green Round.*

Flavor good but not nutty; length and diameter about 5½ by 5 inches; crop uncertain. (No. 3.)

10618. *Large Green.*

Best of all in flavor; flesh smooth, firm, and fiberless; seed small; decidedly bottle-necked; length 7 inches, diameter about 4 inches; late cropper, but crop fairly constant; ripening about middle of June; seed small. (No. 6.)

10619. *Small Green.*

A very early variety, not of best flavor, with fiberless fruit; seed large; not decidedly pear-shaped; good grower and constant cropper; ripening about May 25; earliest variety in Honolulu. (No. 5.)

10620. *Large Green.*

Flavor decidedly nutty and good; flesh yellow, fiberless; length and diameter of fruit about standard; crop light, ripening about the middle of June. (No. 2.)

10621. PHLEUM PRATENSE. **Timothy.**

From Södermanland, Sweden. Presented by Prof. Jakob Eriksson, Experimentalfältet Albano, Stockholm. Received April 20, 1904.

"Sample of seed from crop of 1903 of Swedish timothy for the selection experiments carried on by Mr. John W. Gilmore at the Cornell University Agricultural Experiment Station." (*Fairchild.*)

10622. ARACHIS HYPOGAEA. **Peanut.**

From Japan. Presented by Prof. C. C. Georgeson, director of the Alaska Agricultural Experiment Station, Sitka, Alaska. Received April 18, 1904.

10623. CONVOLVULUS sp. **Japanese morning-glory.**

From Japan. Presented by Prof. C. C. Georgeson, director of the Alaska Agricultural Experiment Station, Sitka, Alaska. Received April 18, 1904.

Seed of Japanese morning-glories, which are known as being the most beautiful varieties in the world.

10624 to 10627.

From Moscow, Russia. Received from Immer & Sons, seedsmen, thru Mr. E. A. Bessey, April 23, 1904.

Seeds, as follows:

10624. Avena sativa. **Oat.**

Belyak. A race of oat bred from the *Svâloff* oat and especially valuable in regions of limited rainfall, where it gives large crops when other sorts fail.

10625. Panicum miliaceum. **Broom-corn millet.**

Orenburger. A low sort, especially bred for large yield in dry regions by the owner of a large estate. Not on the market. Obtained by Immer & Sons from the breeder as a personal favor to them.

10626. Trifolium pratense. **Red clover.**

Red-clover seed from an estate at Kostroma, 150 miles north of Moscow, a region of very cold winters, almost at the edge of clover-seed production.

10627. Trifolium pratense. **Red clover.**

Red-clover seed from an estate in the northern part of Simbirsk government, a region of cold winters with little snow.

10628. BETA VULGARIS. **Beet.**

From Catania, Sicily. Received thru Mr. Alwin Berger, La Mortola, Ventimiglia, Italy. Received April 21, 1904.

"Sample of beet seed from the director of the Royal Botanic Gardens in Catania for the breeding experiments of Dr. C. O. Townsend and Mr. E. C. Rittue, of this Department." (*Fairchild.*)

10629 and 10630. BETA MARITIMA.

From Sicily. Received thru Dr. Carl Sprenger, Vomero, near Naples, Italy, April 25, 1904.

"Sample of seed from two different localities in Sicily for the breeding experiments of Doctor Townsend and Mr. Rittue, of this Department. No. 10629 was marked 'I' and No. 10630 was marked 'II.' No further information." (*Fairchild.*)

10631. CAESALPINIA BREVIFOLIA. **Algarobillo.**

From New York. Received thru A. Klipstein & Co., 122 Pearl street, New York, N. Y., March 23, 1904.

Pods of the tannin shrub "algarobillo." This is a small tree found growing wild on the foothills of the Andes in Chile. It is said to occur in the driest portions of the arid coast and to produce large quantities of pods very rich in tannin. According to Dr. Louis E. Levi, of the Pfister & Vogel Leather Company, of Milwaukee, Wis., "it is an excellent tanning material, but gives a very light yellow color to the leather, which is partially objectionable, yet I think in mixtures with quebracho, or the like, it would answer the purpose of the tanner. The same contains about 50 per cent of tannin. The tannin material has as yet not been used very much in the United States on account of its objectionable color and easily fermentable properties when in solution. I think this is not very objectionable, as an experienced tanner would be able to get around this fault."

Mr. C. A. Spencer, importer and dealer in tanning materials, 183 Essex street, Boston, Mass., says: "Regarding the value of this material as a tanning agent, we may say its use for the purpose is very limited. While it is very strong in tannin it does not have the filling properties that make it a desirable material for the manufacture of leather, altho there is a limited quantity used in Great Britain and Europe, but from the best information we have been able to obtain, there are only about 1,000 tons yearly of this article available. As compared with other tanning materials grown in the United States, and with quebracho extract, gambier, etc., the price is somewhat higher, which no doubt accounts, to a certain extent, for its limited consumption. We formerly imported this article regularly, but the demand for it has grown much less during the past two years, and there are now practically but two consumers in this country of any size who are using the article in the manufacture of what they call gambier extract."

Mr. William H. Krug, of A. Klipstein & Co., 122 Pearl street, New York, N. Y., says: "We are unable to give you a comparative statement as to the value of this material as compared with the other tanning materials you mention in your letter, as it has been only very recently introduced in this country and has not received more than a very limited application. We believe with you that algarobillo can no doubt be successfully grown in some regions of the United States, and with the growing scarcity of domestic tanning materials, its introduction should prove of considerable interest."

10632. PERILLA OCYMOIDES. **Perilla.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company April 25, 1904.

"Sent to replace the former quantity imported (see No. 9892), which failed to germinate." (*Fairchild.*)

10633. QUERCUS CORNEA. **Oak.**

From Hongkong, China. Presented by Mr. S. T. Dunn, superintendent of the Botanical and Afforestation Department. Received April 27, 1904.

"Acorns of an evergreen oak, said to be a very showy ornamental as grown on the island of Hongkong, but interesting particularly as bearing acorns as hard shelled as the nuts of the American hickory and which contain a kernel almost as sweet as the sweetest Spanish chestnut. These acorns are sold in the markets of Canton and Hongkong by the ton and are keenly relished not only by the Japanese but by Europeans. Altho difficult to predict how hardy this species will be in America, it is worthy of trial in all regions where citrus fruits can be grown." (*Fairchild.*)

10634. STACHYS SIEBOLDII. **Chinese artichoke.**

From London, England. Presented by Mrs. Theo. K. Gibbs, Bethshan, Gibbs avenue, Newport, R. I. Received April 29, 1904.

"These tubers are considered a great delicacy in France, where they are served in the best restaurants and command a good price. They are said to be more delicate than potatoes and are certainly worthy of a permanent place among the new vegetables of this country. They should be planted in rows a foot apart and 6 to 9 inches in the row as soon as all danger from frost is past. They mature their tubers in October, when they may be dug and stored in sand or earth in a cool place. They should be prepared by boiling, steaming, or roasting, and may be served either dry or with melted butter. Fried with salad oil they are considered to be especially delicious. Purchased by Mrs. Gibbs from Peter Barr, of London." (*Fairchild.*)

10635. PENTZIA VIRGATA. **Karoobosch.**

From Ward No. 3, Jansenville, South Africa. Received thru Messrs. Lathrop and Fairchild by arrangement with Dr. Charles P. Lounsbury and Mr. A. J. Davison, of the Department of Agriculture, Cape Town, South Africa, May 2, 1904.

"This fodder composite is considered of such great value by the sheep and cattle men of Cape Colony that a separate circular regarding it is being prepared. It is a low-growing, spreading bush which layers naturally when the tips of its branches arch over and touch the ground. In the eastern provinces of Cape Colony, where the rains occur in summer but where long, severe droughts are frequent, this Pentzia is one of the most valuable of all the Karroo plants for fodder purposes. It is especially good for sheep and goats, which eat it down almost to the ground. Tho tested unsuccessfully in Australia, the plant is of such great value that it deserves a thoro trial in the warmest parts of America and should be used in experiments on resuscitation of the barren island ranges of Hawaii." (*Fairchild.*)

10636 to 10669. MANGIFERA INDICA. **Mango.**

From Seharunpur, India. Presented by Mr. W. Gollan, superintendent of the Government Botanical Garden, to replace plants that died in transit last year. Received April 26, 1904.

10636 to 10639—Continued.

Plants as follows (notes by Mr. Gollan):

10636. *Arbuthnot.*

Something like *Bombay Yellow*, but a smaller fruit.

10637. *Brindabani.*

Medium-sized, green-colored fruit. Quality only fair.

10638. *Bombay Green.*

Something like *Bombay Yellow*, but fruit green when ripe.

10639. *Bombay Yellow.*

The best mango here. Fruit of medium size and yellowish when ripe.

10640. *Gopal Bhog.*

Medium-sized fruit. Keeps well. Flavor good.

10641. *Khapariah.*

A longish, hooked, pointed fruit. Color yellow, shaded red.

10642. *Salibunda.*

A large fruit. Subacid flavor. Color greenish yellow.

10643. *Strawberry.*

A longish, hooked, pointed fruit. Flavor good.

10644. *Calcuttia Amin.*

A long fruit, hooked, pointed. Has a very thin stone. Flavor good.

10645. *Faizan.*

A large, long fruit. Brownish green. Flavor good.

10646. *Fijri Long.*

A large, longish fruit. Ripens late. Dark green when ripe.

10647. *Fijri Round.*

Similar to above but of roundish shape.

10648. *Hathi Jhul.*

A very large fruit. Flavor good.

10649. *Kachmahua.*

A small fruit, but of good flavor.

10650. *Kakaria.*

A large, long fruit. Dark green. Good flavor.

10651. *Langra Hardoi.*

A medium-sized fruit. Ripens late. Pale yellow flesh. Very rich.

10652. *Surkha.*

A stringy kind, but of very good flavor.

10653. *Tamancha.*

A large fruit. Greenish yellow. Flavor good.

10654. *Bhadauria.*

A small, dark-green fruit. Ripens in September–October.

10655. *Punia.*

A medium-sized, stringy kind. Flavor very good.

10656. *Kistaphal.*

A large fruit. Flesh highly colored and of good flavor.

10636 to 10639—Continued.

10657. *Madras.*

A small fruit. Stringy but of fine flavor.

10658. *Romani.*

A medium-sized fruit. Subacid, of very fine flavor.

10659. *Nucka.*

A long, hooked, pointed fruit. Slightly stringy, but flavor good.

10660. *Chickna.*

A medium-sized fruit. Light yellow, of good flavor.

10661. *Davy's Favorite.*

A long, thin fruit. Yellow, shaded red.

10662. *Gola.*

A large, round, yellow fruit, of very good flavor.

10663. *Pyasee.*

A medium-sized fruit, of subacid flavor. Good.

10664. *Langra Large.*

Similar to *Langra Hardoi*, but larger. Ripens late in August.

10665. *Sundershah.*

A long fruit. Stringy. Flavor peculiar and only liked by some people.

10666. *Kala.*

A longish-shaped fruit. Pale green. Free of stringiness. Good.

10667. *Sanduriah.*

A small, long-shaped fruit. Stringy, but of fine flavor.

10668. *Naji Hahadi Amin.*

A medium-sized, dark-green fruit. Ripens late.

10669. *Sharhati Black.*

A large, round fruit. Dark green. Of very good flavor.

10670 to 10673. NEPHELIUM LITCHI and NEPHELIUM LONGANA.
Litchi and longan.

From Hing-hua, Fuhkien, China. Received thru Rev. W. N. Brewster, Methodist Episcopal missionary, in the autumn of 1903.

Mr. Brewster says: "They were grafted probably some time in the year 1902. The trees were not more than two years old, I think. With regard to the culture, they are not propagated from the seed, but a ball of earth is tied around a joint of a branch, and when it throws roots out into this ball the branch is cut off on the side next to the trunk, and the little tree is planted. The trees are fertilized by night soil about the time that they are blossoming and also later when the fruits begin to form. When the leaves are too thick, as they generally are in the spring, there is severe pruning done. After the buds are out, these are also thinned; after the blossoms begin to form into fruit they are thinned again. This is very important in order to make a perfect fruit. They must be kept entirely free from frost, and should be planted in a deep soil, i. e., the soil should be soft down many feet below the surface. The *litchi* blossoms early and matures the latter part of July. It is shaped like a strawberry and has the strawberry color and appearance, only the skin is rough and thick and brittle. The seed of the grafted variety is sharp pointed and small, and shriveled up so that the meat is much more abundant than in the ungrafted variety. The meat is white and juicy and a little tart. The *longan* (another species of the same genus) ripens in September. It is round and smooth. It is sweeter than the *litchi*, but the meat has very much the same appearance.

"The other fruit which I brought, the *longan*, is not a variety of the *litchi*, but a distinct fruit, different in color and taste, and matures several weeks later in the season. Many people think it is equal to, and some think it far superior to, the *litchi*. It is cultivated in the same way as the latter, so far as I have observed."

10674. Hordeum tetrastichum. **Four-row barley.**

From Chicago, Ill. Received thru Wahl-Henius Institute of Fermentology, May 3, 1904.

"Minnesota barley which, according to Dr. Robert Wahl's analysis, contains the unusual percentage of 15 to 16 per cent of protein. Doctor Wahl believes that this variety should be experimented with in connection with the testing of low-protein, two-rowed barleys. It is also of interest in connection with the experiments of Mr. H. M. Cottrell, Odebolt, Iowa, on high nitrogen feeding barleys." (*Fairchild.*)

10675 to 10723.

From Teneriffe, Canary Islands. Received thru Hon. Solomon Berliner, United States consul at Teneriffe, May 4, 1904. Transmitted thru the Secretary of State.

A collection of small samples of seeds, many of them indigenous to the Canary Islands, as follows:

10675. Asphodelus ramosus.
10676. Artemisia argentea.
10677. Bosea yervamora.
10678. Bystropogon origanifolius.
10679. Centaurea calcitrapa.
10680. Cineraria populifolia argentea.
10681. Chrysanthemum frutescens.
10682. Convolvulus althaeoides.
10683. Convolvulus floridus.
10684. Cytisus glabratus.
10685. Cytisus palmensis.
10686. Delphinium staphisagria.
10687. Digitalis canariensis.
10688. Dracaena draco.
10689. Dracunculus canariensis.
10690. Echium formosum.
10691. Echium simplex.
10692. Echium strictum.
10693. Euphorbia canariensis.
10694. Euphorbia regis-jubae.
10695. Ferula linkii.
10696. Galilea juncea.
10697. Genista canariensis.
10698. Genista monosperma.
10699. Gladiolus segetum.
10700. Gonospermum fruticosum.
10701. Gonospermum revolutum.
10702. Hypericum floribundum.
10703. Lavandula abrotanoides.
10704. Leucophae candidissima.
10705. Lotus canariensis floribunda.
10706. Mesembryanthemum crystallinum.
10707. Oenothera rosea.
10708. Parietaria arborea.
10709. Periploca laevigata.
10710. Pinus canariensis.
10711. Plocama pendula.
10712. Psoralea bituminosa.
10713. Ranunculus canariensis.
10714. Rhamnus crenulata.
10715. Rhodocistus berthelotianus.
10716. Rubia fruticosa.
10717. Rumex lunaria.
10718. Sempervivum tabulaeforme.
10719. Statice brassicaefolia.
10720. Statice pectinata.
10721. Tamus edulis.
10722. Teucrium hyssopifolium.
10723. Verbena bonariensis.

10724. Vicia faba. **Horse bean.**

From Cairo, Egypt. Received thru Mr. George P. Foaden, secretary of the Khedivial Agricultural Society.

"Roots of this forage plant collected shortly before harvest time, dried in the shade, and mailed in tin mailing cases. For Doctor Moore's experiments in the isolation of the micro-organism which causes the tubercles." (*Fairchild.*)

10725. Medicago orbicularis.

From Algeria. Secured by Mr. Thomas H. Kearney in 1902. Turned over to this office by Mr. C. S. Scofield on May 5, 1904, to be numbered and sent to the Plant Introduction Garden at Chico, Cal., for propagation.

10726. Phleum pratense. **Timothy.**

From Helsingfors, Finland. Received thru Mr. C. T. Ward, Finnish Horticultural Society, May 6, 1904.

Sample of timothy seed grown in Finland.

10727 to 10750.

From Monte, Grand Canary. Presented by Mr. Alaricus Delmard. Received May 6, 1904.

A collection of small samples of seeds of interesting plants growing in the Canary Islands, as follows:

10727. Adenocarpus frankenioides.
10728. Bosea yervamora.
10729. Bystropogon origanifolius.
10730. Cedronella canariensis.
10731. Chrysanthemum frutescens.
10732. Clethra arborea.
10733. Isolepis canariensis.
10734. Cytisus palmensis.
10735. Delphinium staphisagria.
10736. Digitalis canariensis.
10737. Galilea juncea.
10738. Gonospermum revolutum.
10739. Leucophae candidissima.
10740. Mesembryanthemum crystallinum.
10741. Oenothera rosea.
10742. Parietaria arborea.
10743. Periploca laevigata.
10744. Rhodocistus berthelotianus.
10745. Rubia fruticosa.
10746. Statice pectinata.
10747. Tamus edulis.
10748. Teucrium hyssopifolium.
10749. Trixago versicolor.
10750. Verbena bonariensis.

10751. Fragaria sp. **Strawberry.**

From Garrettsville, Ohio. Presented by the originator, Mr. George J. Streator, for testing, on condition that no distribution is made. Received May 9, 1904.

Cardinal.

10752. Ervum lens. **Lentil.**

From Cairo, Egypt. Received thru Mr. George P. Foaden, secretary of the Khedivial Agricultural Society, May 6, 1904.

Saida. "A variety of an important crop grown extensively in Upper Egypt." (*Fairchild.*)

10753. VICIA FABA. **Horse bean.**

From Valetta, Malta. Received thru Dr. J. Borg, San Antonio Gardens, May 12, 1904.

Roots of a horse bean from the island of Malta, which, according to Doctor Borg, were from plants already in pod. Doctor Borg remarks that the nodules are not so plump as they were when the plant was just beginning to set fruit, and that the roots came from the best bean-producing lands in Malta, lands entirely free from orobanche, which is a bad weed in the bean fields and their worst enemy. "But for its ravages the bean would be the most profitable crop for agriculture." (*Borg.*)

10754. HORDEUM TETRASTICHUM. **Four-row barley.**

Originally from the Agricultural Experiment Station at Madison, Wis. Received thru the Wahl-Henius Institute of Fermentology, Chicago, Ill., May 9, 1904.

Oderbrucker. "A variety of barley which, upon analysis, proves to contain 15 per cent of protein matter. Dr. Robert Wahl considers it essential that this type of barley with high nitrogen content be experimented with for beer-making purposes, and Mr. H. M. Cottrell, of Odebolt, Iowa, is interested in it as a type especially adapted for feeding purposes." (*Fairchild.*)

10755 and 10756. CAPSICUM ANNUUM. **Paprika pepper.**

From Budapest, Hungary. Received thru Hon. Frank D. Chester, United States consul at Budapest, May 4, 1904.

Seeds of the two varieties of *paprika* which were requested by the Botanical Drug Company, of Bridgeport, Ala.

10755. *Szeged rose.*

From Szeged, Hungary.

10756. *Hungarian.*

From near Debreczen, Hungary.

"It is worthy of note that the best varieties of paprika are not imported into this country and that the highest priced, called 'Edelsüss,' brings 6 crowns a pound, while that generally imported into America is quoted at 1.65 crowns. There would seem to be a chance for the paprika industry in America." (*Fairchild.*)

10757 to 10958. PHOENIX DACTYLIFERA. **Date.**

From Biskra, Algeria. Purchased from Monsieur Colombo by correspondence conducted by Mr. W. T. Swingle. Plants paid for by Mr. E. A. Bessey, who superintended the packing and shipping to the United States. Received May 17, 1904.

10757 to 10832. *Deglet Noor.* From Ourlana oasis.

Among these palms there may be as many as four palms that are not *Deglet Noors*, since four lost their numbers and were confused with this lot of *Deglet Noors*. Nos. 10841, 10883, 10902, and 10904 are doubtful, and are probably *Deglet Noors*. The varieties of these four misplaced suckers are as follows: *Tezerharit*, *Abd en noor*, *Sokria*, and *Iteema*. These varieties are mostly quite unlike the *Deglet Noor* and can probably be recognized when the offshoots get of some size.

10833. *Deglet Beida.* From Ourlana oasis.

10834. *Deglet Beida.* From Ourlana oasis.

10835. *Deglet Beida.* From Ourlana oasis.

10836. *Tenaseen.* From Ourlana oasis.

10837. *Tenaseen.* From Ourlana oasis.

10838. *Tenaseen.* From Ourlana oasis.

10839. *Tezerharit.* From Ourlana oasis.

10840. *Tezerharit.* From Ourlana oasis.

10841. (No label.)

10757 to 10958—Continued.

10842. *Oreloo.* From Ourlana oasis.
10843. *Oreloo.* From Ourlana oasis.
10844. *Oreloo.* From Ourlana oasis.
10845. *Sayba Boo Dra.* From Ourlana oasis.
10846. *Sayba Boo Dra.* From Ourlana oasis.
10847. *Sayba Boo Dra.* From Ourlana oasis.
10848. *Sayba Boo Dra.* From Ourlana oasis.
10849. *Tafazweent.* From Ourlana oasis.
10850. *Tafazweent.* From Ourlana oasis.
10851. *Tafazweent.* From Ourlana oasis.
10852. *Taoorkhet.* From Ourlana oasis.
10853. *Taoorkhet.* From Ourlana oasis.
10854. *Taoorkhet.* From Ourlana oasis.
10855. *Taty.* From Ourlana oasis.
10856. *Taty.* From Ourlana oasis.
10857. *Taty.* From Ourlana oasis.
10858. *Timjoohert.* From Ourlana oasis.
10859. *Timjoohert.* From Ourlana oasis.
10860. *Timjoohert.* From Ourlana oasis.
10861. *Temkhookh.* From Ourlana oasis.
10862. *Temkhookh.* From Ourlana oasis.
10863. *Temkhookh.* From Ourlana oasis
10864. *Takadet.* From Ourlana oasis.
10865. *Takadet.* From Ourlana oasis.
10866. *Takadet.* From Ourlana oasis.
10867. *Taremoont.* From Ourlana oasis.
10868. *Taremoont.* From Ourlana oasis.
10869. *Taremoont.* From Ourlana oasis.
10870. *Nakhelet Mzian.* From Ourlana oasis.
10871. *Nakhelet Mzian.* From Ourlana oasis.
10872. *Nakhelet Mzian.* From Ourlana oasis.
10873. *Adebet et Teen.* From Ourlana oasis.
10874. *Adebet et Teen.* From Ourlana oasis.
10875. *Adebet et Teen.* From Ourlana oasis.
10876. *Makelet el Leef.* From Ourlana oasis.
10877. *Makelet el Leef.* From Ourlana oasis.
10878. *Makelet el Leef.* From Ourlana oasis.
10879. *Nakhelet Feraoon.* From Ourlana oasis.
10880. *Nakhelet Feraoon.* From Ourlana oasis.
10881. *Nakhelet Feraoon.* From Ourlana oasis.
10882. *Abd en Noor.* From Ourlana oasis.
10883. (No label.)
10884. *Abd en Noor.* From Ourlana oasis.
10885. *Horra.* From Fougala oasis.

10757 to 10958—Continued.

10886. *Horra.* From Fougala oasis.
10887. *Horra.* From Fougala oasis.
10888. *Rhazee.* From Fougala oasis.
10889. *Rhazee.* From Fougala oasis.
10890. *Rhazee.* From Fougala oasis.
10891. *Toory.* From Fougala oasis.
10892. *Toory.* From Fougala oasis.
10893. *Toory.* From Fougala oasis.
10894. *Oogbales.* From Fougala oasis.
10895. *Oogbales.* From Fougala oasis.
10896. *Oogbales.* From Fougala oasis.
10897. *Sokria.* From Biskra oasis.
10898. *Boo Halas.* From Biskra oasis.
10899. *Sokria.* From Biskra oasis.
10900. *Sokria.* From Biskra oasis.
10901. *Sokria.* From Biskra oasis.
10902. (No label.)
10903. *Iteema.* From Biskra oasis.
10904. (No label.)
10905. *M'Kentishee Degla.* From Biskra oasis.
10906. *M'Kentishee Degla.* From Biskra oasis.
10907. *M'Kentishee Degla.* From Biskra oasis.
10908. *Retbet Hafsia.* From Biskra oasis.
10909. *Retbet Hafsia.* From Biskra oasis.
10910. *Getara.* From Biskra oasis.
10911. *Getara.* From Biskra oasis.
10912. *Zoozia.* From Biskra oasis.
10913. *Retbet Regaya.* From Biskra oasis.
10914. *Retbet Regaya.* From Biskra oasis.
10915. *Retbet Regaya.* From Biskra oasis.
10916. *Mnooar* (male). From Filiache oasis.
10917. *Retbet Haloo.* From Filiache oasis.
10918. *Retbet Haloo.* From Filiache oasis.
10919. *Retbet Haloo.* From Filiache oasis.
10920. *Halooa.* From Biskra oasis.
10921. *Halooa.* From Biskra oasis.
10922. *Halooa.* From Biskra oasis.
10923. *Zerza.* From Biskra oasis.
10924. *Zerza.* From Biskra oasis.
10925. *Zerza.* From Biskra oasis.
10926. *Boo Halas.* From Biskra oasis.
10927. *Boo Halas.* From Biskra oasis.
10928. *Boo Halas.* From Biskra oasis.
10929. *Khodry.* From Biskra oasis.

10757 to 10958—Continued.

10930. *Khodry.* From Biskra oasis.
10931. *Khodry.* From Biskra oasis.
10932. *Lookzy.* From Filiache oasis.
10933. *Lookzy.* From Filiache oasis.
10934. *Rhazee.* From Filiache oasis.
10935. *Rhazee.* From Filiache oasis.
10936. *Rhazee.* From Filiache oasis.
10937. *Mnooar* (male). From Filiache oasis.
10938. *Mnooar* (male). From Filiache oasis.
10939. *Iteem Joher.* From Filiache oasis.
10940. *Iteem Joher.* From Filiache oasis.
10941. *Iteem Joher.* From Filiache oasis.
10942. *Goondy.* From Filiache oasis.
10943. *Goondy.* From Filiache oasis.
10944. *Goondy.* From Filiache oasis.
10945. *Lookzy.* From Filiache oasis.
10946. *Ahmar Msab.* From Chetma oasis.
10947. *Ahmar Msab.* From Chetma oasis.
10948. *Ahmar Msab.* From Chetma oasis.
10949. *Retbet Abdala.* From Chetma oasis.
10950. *Retbet Abdala.* From Chetma oasis.
10951. *Retbet Abdala.* From Chetma oasis.
10952. *Sokria.* From Chetma oasis.
10953. *Sokria.* From Chetma oasis.
10954. *Sokria.* From Chetma oasis.
10955. *Nesheen.* From Chetma oasis.
10956. *Nesheen.* From Chetma oasis.
10957. *Nesheen.* From Chetma oasis.
10958. (No label.)

10959. SECHIUM EDULE. **Chayote.**

From New Orleans, La. Received thru the J. Steckler Seed Company (Limited). Received May 10, 1904.

"Fruits of the commercial variety common in New Orleans markets." (*Fairchild.*)

10960. MANGIFERA INDICA. **Mango.**

From Tahiti. Received April 26, 1904.

"Seed of a fruit of a variety of mango brought by the captain of the steamer *Mariposa* to San Francisco. The captain declares it to be a superior variety, very free from fiber and very luscious. A fruit of this variety was eaten by Mr. George W. Oliver and he declares it an excellent variety. The captain says there are many trees of this variety in Tahiti. Owing to its large size and freedom from fiber it may prove valuable." (*Fairchild.*)

10961. (Undetermined.)

From Arcelia, Guerrero, Mexico. Presented by Mr. Federico Chisolm. Received May 5, 1904.

A small packet of flower seed. Flower described by Mr. Chisolm as follows: "Perennial blue flower, yellow center. Twelve inches to 20 inches. Blooms June, July, August, December, January, and February. Desirable for bedding."

10962. VICIA FABA. **Horse bean.**

From Tunis, Tunis. Received thru Mr. R. Gagey, Agricultural College, Tunis, May 17, 1904.

"Roots of horse bean, dried in the shade, for material from which to secure the micro-organism which forms the nitrogen-collecting nodules." (*Fairchild.*)

10963. LILIUM NEILGHERRENSE. **Neilgherry lily.**

From Utakamand, India. Presented by Mr. H. F. Macmillan, curator, Royal Botanic Garden, Peradeniya, Ceylon, thru Mr. Fairchild, May 20, 1904.

10964. GOSSYPIUM TOMENTOSUM. **Cotton.**

From Honolulu, Hawaii. Presented by Mr. Jared G. Smith, special agent in charge of the Agricultural Experiment Station, May 18, 1904.

10965. MUSA SAPIENTUM. **Banana.**

From Grand Canary, Canary Islands. Received thru Mr. Alaricus Delmard, May 20, 1904.

"Suckers of the so-called 'Chinese' banana, commonly grown in the Canary Islands and shipped to England in large quantities. It is reported that this variety of banana brings a higher price on the London market than the Jamaican or Central American varieties." (*Fairchild.*)

10966. LILIUM PHILIPPINENSE. **Lily.**

From Manila, P. I. Received from Mr. Elmer D. Merrill, botanist of the Bureau of Government laboratories, Manila, thru Capt. George P. Ahern, May 28, 1904.

"*Benguet* lily, introduced especially for experiments in hybridizing lilies." (*Fairchild.*)

10967. FURCRAEA FOETIDA.

From Port Luis, Mauritius. Presented by Mr. John W. Holway, United States vice-consul, to Mr. L. H. Dewey. Received May 10, 1904.

"My principal object in introducing them is to determine whether there is any difference between Porto Rico 'maguey' and Mauritius 'alser vert.'" (*Dewey.*)

10968. MAGNOLIA PUMILA. **Magnolia.**

From Canton, China. Presented by Mr. Thomas Griffith. Received May 23, 1904.

"Plants of an ornamental known in Canton as 'Yei-hap.' Said by Captain Bernadou, of the United States Navy, to be a great favorite among the Chinese, the flowers, which are fragrant, being used for boutonnieres. Occasionally cultivated in the South." (*Fairchild.*)

10969 to 10974.

Presented by Mr. Frederick Cramer, thru Dr. L. O. Howard. Received May 23, 1904.

10969. (Undetermined.) **Cactus.**

From the City of Mexico, Mexico.

"A low-growing species of cactus, the small berry-like cactus fruit of which is said to be edible. Probably comes from Michoacan." (*Fairchild.*)

10970. CITRUS AURANTIUM. **Orange.**

From Atotonilco, State of Jalisco, near Guadalajara, Mexico.

Telon. Said to be the very best seedling orange raised in southern Mexico. "Like a lemon but round like an apple. Sweet tasting." (*Fairchild.*)

10971.

From the City of Mexico, Mexico.

A collection of seeds secured by Mr. Cramer from all over Mexico, mostly of ornamental flowers, shrubs, and trees.

10969 to 10974—Continued.

10972. (Undetermined.)

From Guadalajara, Mexico.

Seeds of a medicinal plant.

10973. CICER ARIETINUM. **Chick-pea.**

From Mexico.

10974. CICER ARIETINUM. **Chick-pea.**

From Jalisco.

"Grown on dry, arid lands in the hotter portions of Mexico without irrigation. The weevils which attack this chick-pea are said to be injurious to other cereals. These seed should be carefully fumigated. Raised in Mexico on heavy, dry, black soil." (*Fairchild.*)

10975. CASTILLA sp. (?).

From Chiapas, Mexico. Presented by Mr. James Maunder, thru Dr. L. O. Howard. Received May 23, 1904.

Mr. Maunder considers this a valuable variety.

10976 and 10977.

From Quito, Ecuador. Presented by Mr. Luis Sodiro, S. J., a botanist and student of Ecuador agriculture. Received May 25, 1904.

10976. FESTUCA PABULARIS. **10977.** POA MULALENSIS.

"Mr. Sodiro remarks that Nos 10976 and 10977 are some of the most remarkable forage grasses of the mountain region of Ecuador. They are likely to prove of value in certain portions of this country." (*Fairchild.*)

10978. PERSEA GRATISSIMA. **Avocado.**

From Guatemala. Presented by Hon. Alfred A. Winslow, consul-general, Guatemala, Central America. Received May 23, 1904.

10979 to 10999.

From Hsi-an, China. Presented by Mr. W. W. Simpson in exchange for seeds of American vegetables sent him in December, 1903. Received May 23, 1904.

Seed as follows:

10979. CANNABIS SATIVA. **Hemp.**

10980.

A mixture, but labeled "Parsley."

10981. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

10982. BRASSICA ALBA. **White mustard.**

10983. BRASSICA ALBA. **White mustard.**

10984. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

10985. HORDEUM VULGARE. **Barley.**

10986. PISUM sp. **Pea.**

10987. PISUM SATIVUM. **Pea.**

10988. ALLIUM CEPA. **Onion.**

10989. BETA VULGARIS. **Beet.**

10990. RAPHANUS SATIVUS. **Spring radish.**

10991. VICIA FABA. **Broad bean.**

10992. TRITICUM VULGARE. **Winter wheat.**

10979 to 10999—Continued.

10993. Trigonella foenum-graecum. **Fenugreek.**

10994. Brassica pe-tsai. **Pe-tsai cabbage.**

10995. Apium graveolens. **Celery.**

10996. Lactuca sativa. **Lettuce.**

10997. Brassica pe-tsai. **Pe-tsai cabbage.**

10998. Lactuca sativa. **Lettuce.**

10999. Lactuca sativa. **Lettuce.**

11000. Phleum pratense. **Timothy.**

From Tokyo, Japan. Received from Mr. T. Watase, president of the Tokyo Plant, Seed, and Implement Company, thru Dr. Oscar Loew, Imperial University, Tokyo, May 31, 1904.

"Seed from Hakkaido, the northern island of Japan." (*Fairchild.*)

11001. Nicotiana tabacum. **Tobacco.**

From Sao Paulo, Brazil. Secured thru Dr. Horace M. Lane, president of the Mackenzie College. Received May 23, 1904.

Criolo.

11002. Pancratium sp.

From Arcelia, Guerrero, Mexico. Presented by Mr. Federico Chisolm. Received June 6, 1904.

11003. Phoenix dactylifera. **Date.**

From Biskra, Algeria. Received thru Monsieur Colombo by Mr. E. F. Chumard, of Imperial, Cal., Mr. E. A. Bessey, of this Department, acting as agent in the transaction, the previous correspondence having been conducted by Mr. Walter T. Swingle.

Deglet Noor.

11004 to 11009.

From Arcelia, Guerrero, Mexico. Received thru Mr. Federico Chisolm, June 15, 1904.

A collection of native Mexican seeds and bulbs as follows:

11004. Psidium molle. **Guayabilla.**

Strawberry-flavored guayabillas.

11005. Psidium molle. **Guayabilla.**

From fruits having at least four distinct flavors.

11006. Spondias purpurea. **Ciruela.**

11007. Spondias purpurea. **Ciruela.**

11008. Lilium sp. (?). **Scarlet lily.**

11009. (Unidentified.)

11010 to 11017.

From Sepacuite, Guatemala. Received thru Mr. O. F. Cook, June 6, 1904.

11010. Ananas sativus. **Pineapple.**

A spiny-leaved pineapple peculiar to this immediate neighborhood, where it grows and ripens at a higher and cooler elevation than any other sort. The leaves are very broad and drooping, giving a very characteristic appearance. The flesh is yellow, and of moderately good quality, inferior to the best hot-country sorts, but better than the latter when grown in these humid highlands. It might be of use in the mountains of Porto Rico, Hawaii, or the Philippines.

11010 to 11017—Continued.

11011. ANANAS SATIVUS. **Pineapple.**

A smooth variety, not native here. Perhaps the Smooth Cayenne.

11012 to 11017. CHAMAEDOREA spp. **Palm.**

A collection of small palms which will be identified later.

11018. TRIFOLIUM PRATENSE. **Red clover.**

From Toledo, Ohio. Received thru S. W. Flower & Co., June 10, 1904.

11019. TRIFOLIUM HYBRIDUM. **Alsike.**

From Toledo, Ohio. Received thru S. W. Flower & Co., June 10, 1904.

11020. PRUNUS sp. **Plum.**

From Moody, Ala. Received thru Mr. D. S. Jones, June 9, 1904.

Yanner. "Bud sticks of a variety of wild plum which, according to Mr. Jones, ripens in Alabama about September 10. If house ripened the plums resemble in taste the *Wild Goose*, but are meatier. When taken from the tree they are bitter, but when mellowed they are excellent. This is a wild sort, probably of the family of the *Wild Goose*, and ripening so late that they are considered valuable for culinary purposes. Altho possibly known to other nurserymen, Mr. Jones does not find them cataloged by any nursery firm. The fruits are medium in size, deep red in color, and they are peculiarly free from disease, seldom being attacked by the curculio." (*Fairchild.*)

11021 to 11033.

From Buitenzorg, Java. Presented by Doctor Treub. Received June 15, 1904.

As follows:

11021. CALOPHYLLUM HASSKARLII.

11022. CALOPHYLLUM KUNSTLERI LONGIFOLIUM.

11023. CALOPHYLLUM SPECTABILE.

11024. CALOPHYLLUM SPECTABILE CERAMICUM.

11025. CALOPHYLLUM SPECTABILE MIQUELLI.

11026. CALOPHYLLUM VENULOSUM.

11027. GARCINIA DIOICA.

11028. GARCINIA DULCIS PYRIFORMIS.

11029. GARCINIA DULCIS SYLVESTRIS.

11030. GARCINIA FUSCA.

11031. GARCINIA LOUREIRI.

11032. GARCINIA XANTHOCHYMUS.

11033. MESUA FERREA.

11034. PRUNUS CERASUS. **Cherry.**

From Moscow, Russia. Received thru Mr. E. A. Bessey, June 15, 1904.

Vladimir. Two-year-old trees (seedlings) of this resistant variety of cherry from the trial gardens of Immer & Son, Moscow.

11035 to 11038. NICOTIANA TABACUM. **Tobacco.**

From Sao Paulo, Brazil. Received thru Dr. Horace M. Lane, president of the Mackenzie College, June 9, 1904.

11035 to 11038—Continued.

Seed of four varieties of tobacco commonly grown in Brazil, as follows:

11035. *Americano fino.*

Grown in the interior of Bahia. The original stock probably came from the United States.

11036. *Bahiano.*

A native variety grown in Bahia, from which the celebrated Bahia leaf is made.

11037. *Santa Cruz.*

A native tobacco grown in Rio Grande do Sul. This sort is highly esteemed.

11038. *Turco.*

Grown around Sao Paulo for many years. The variety is of Asiatic origin.

11039 to 11119.

From Abyssinia, Africa. Received thru Hon. Robert P. Skinner, commissioner of the United States to Abyssinia, June 3, 1904.

"A collection of seeds made for Mr. Skinner, under his direction, by M. Eugène Carette Bouvet, of the Diré-Daoua, Voie de Djibouti, Côte Française des Somalis. This collection represents, in the main, crops cultivated by the Abyssinians." (*Fairchild*).

11039. Triticum durum.

11040. Hordeum sp.

11041. Hordeum sp.

11042. Hordeum sp.

11043. Hordeum sp.

11044. Hordeum sp.

11045. Gossypium sp.

11046. Gossypium sp.

11047. Gossypium sp.

11048. Gossypium sp.

11049. Triticum sp.

11050. Triticum sp.

11051. Triticum sp.

11052. Triticum sp.

11053. Triticum sp.

11054. Triticum sp.

11055. Phaseolus vulgaris.

11056. Phaseolus vulgaris.

11057. Phaseolus vulgaris.

11058. Andropogon sorghum.

11059. Andropogon sorghum.

11060. Andropogon sorghum.

11061. Andropogon sorghum.

11062. Andropogon sorghum.

11063. Andropogon sorghum.

11064. Andropogon sorghum.

11065. Andropogon sorghum.

11066. Andropogon sorghum.

11067. Andropogon sorghum.

11068. Ricinus sp.

11069. Ricinus sp.

11070. Ricinus sp.

11071. Ricinus sp.

11072. Ricinus sp.

11073. Ricinus sp.

11074. Vigna sinensis.

11075. Vigna sinensis.

11076. Vigna sinensis.

11077. Coriandrum sativum.

11078. Coffea sp.

11079. Linum usitatissimum.

11080. Ervum lens.

11081. Brassica oleracea.

11082. Andropogon sorghum.

11083. Andropogon sorghum.

11084. Andropogon sorghum.

11085. Andropogon sorghum.

11086. (Unidentified.)

11087. Trigonella foenum-graecum.

11088. Trigonella foenum-graecum.

11089. (Unidentified.)

11090. Vigna sinensis.

11091. Vigna sinensis.

11092. (Unidentified.)

11093. Guizotia oleifera.

11039 to 11119—Continued.

11094. Triticum dicoccum.
11095. Cicer arietinum.
11096. Lepidium sativum.
11097. Pisum sativum.
11098. Phaseolus radiatus.
11099. Triticum durum.
11100. Eleusine coracana.
11101. Coriandrum sativum.
11102. Vicia faba.
11103. Vicia faba.
11104. (Unidentified.)
11105. Ervum lens.
11106. Zea mays.
11107. Guizotia oleifera.
11108. Capsicum frutescens.
11109. Cicer arietinum.
11110. Cicer arietinum.
11111. Pisum sp.
11112. Pisum sp.
11113. Linum usitatissimum.
11114. Centaurea sp.
11115. Carthamus tinctorius.
11116. Hordeum sp.
11117. Eragrostis abyssinica.
11118. Eragrostis abyssinica.
11119. Andropogon sorghum.

11120 to 11127.

From Santa Barbara, Cal. Received thru Dr. F. Franceschi, June 20, 1904.

A collection of plants for experimental work carried on in cooperation with Prof. Haven Metcalf, of the South Carolina Agricultural Experiment Station, Clemson, S. C.

11120. Passiflora coerulea.
11121. Passiflora edulis.
11122. Passiflora pfordii.
11123. Passiflora manicata.
11124. Passiflora acerifolia.
11125. Passiflora ligularis.
11126. Passiflora alata.
11127. Tacsonia exoniensis.

11128. Phoenix dactylifera. **Date.**

From Fayum, Egypt. Received thru Mr. H. A. Rankin, of the Egyptian Market Company (Limited), June 21, 1904.

Wahi.

11129 to 11236.

Miscellaneous seed on hand July 1, 1904. Numbered to facilitate the keeping of record of distribution.

11129. Agropyron tenerum. **Slender wheat-grass.**

From Northrup, King & Co., Minneapolis, Minn.

11130. Agrostis alba. **Redtop.**

11131. Andropogon halepensis. **Johnson grass.**

11132 to 11136. Andropogon sorghum. **Sorghum.**

11132. *Colman.*
11133. *Amber.*
11134. *Folger.*
11135. *Kansas Orange.*
11136. *Collier.*

11137. Andropogon sorghum. **Kafir corn.**

White.

11138. Andropogon sorghum. **Milo.**

White.

11139. Anthoxanthum odoratum. **Sweet vernal grass.**

11129 to 11236—Continued.

11140. ARACHIS HYPOGAEA. **Peanut.**

Spanish. Received March 25, 1904.

11141. ARRHENATHERUM ELATIUS. **Tall meadow oat-grass.**

11142. ATRIPLEX SEMIBACCATA. **Saltbush.**

Received from the California Experiment Station.

11143. ARRHENATHERUM ELATIUS. **Tall meadow oat-grass.**

11144 to 11151. AVENA SATIVA. **Oat.**

11144. *Banner.*
11145. *Burt.*
11146. *California White.*
11147. *Dakota Gray.*
11148. *Green Mountain.*
11149. *Hopetown.*
11150. *Improved American.*
11151. *Swiss White.*

11152 to 11163. BETA VULGARIS. **Sugar beet.**

11152. *Kleinwanzleben.*

From Utah Sugar Refining Company, Lehi, Utah. (Seed Lab. No. 12846.)

11153. *Kleinwanzleben.*

From H. C. & J. B. Agnew, Agnew, Cal. (Seed Lab. No. 12848.)

11154.

From E. H. Morrison, Fairfield, Wash. (Seed Lab. No. 13007.)

11155. *Kleinwanzleben Nachzucht.*

From H. Bennecke & Son, Germany.

11156.

From the Alma Sugar Company, Alma, Mich.

11157.

From France.

11158. *Kleinwanzleben.*

11159. *Mangel-wurzel.*

11160. *Kleinwanzleben.* (Michigan grown.)

From Pennsylvania Sugar Refinery.

11161. *Hoerning's Improved Kleinwanzleben Special Elite.*

11162.

From Utah Sugar Company, Lehi, Utah. Crop of 1901. (Seed Lab. No. 12756.)

11163.

From H. C. & J. B. Agnew, Agnew, Cal. (Seed Lab. No. 12790.)

11164. ANDROPOGON SORGHUM. **Broom corn.**

Tennessee Evergreen.

11165. BRASSICA NAPUS. **Rape.**

Dwarf Essex.

11166. BROMUS INERMIS. **Smooth brome-grass.**

11167. BROMUS UNIOLOIDES. **Rescue grass.**

From J. M. Thorburn & Co., 36 Cortlandt street, New York, N. Y.

11168. CHAETOCHLOA ITALICA. **German millet.**

11169. CAPRIOLA DACTYLON. **Bermuda grass.**

11170. CICER ARIETINUM. **Chick-pea.**

11129 to 11236—Continued.

11171. Dactylis glomerata. **Orchard grass.**

11172. Euchlaena mexicana. **Teosinte.**

11173. Fagopyrum esculentum. **Buckwheat.**

11174. Festuca elatior. **Tall fescue.**

11175. Festuca heterophylla. **Various-leafed fescue.**

11176. Festuca ovina. **Sheep's fescue.**

11177. Festuca pratensis. **Meadow fescue.**

11178. Festuca rubra. **Red fescue.**

11179. Glycine hispida. **Soy bean.**

Early Black.

11180. Glycine hispida. **Soy bean.**

Yellow.

11181 to 11186. Gossypium barbadense. **Egyptian cotton.**

- **11181.** *Mit Afifi.* (Plant Breeding No. 56.)
- **11182.** *Jannovitch.* (Plant Breeding No. 63.)
- **11183.** *Ashmuni.* (Plant Breeding No. 59.)
- **11184.** *Mit Afifi.* (Plant Breeding No. 55.)
- **11185.** *Ashmuni.* (Plant Breeding No. 62.)
- **11186.** *Ashmuni.* (Plant Breeding No. 61.)

11187 to 11190. Gossypium sp. **Cotton.**

- **11187.** (No label.)
- **11188.** *King.*
- **11189.** *Rivers.*
- **11190.** *Upland.*

11191. Helianthus annuus. **Sunflower.**

Received from the Division of Chemistry in 1901.

11192. Hordeum vulgare. **Barley.**

Manchurian. From the Minnesota Agricultural Experiment Station. (Minn. No. 105.)

11193. Hordeum vulgare. **Barley.**

Tennessee Winter. From the Tennessee Agricultural Experiment Station.

11194. Lathyrus stipularis.

11195. Lathyrus azureus.

11196. Lathyrus coccineus.

11197. Lathyrus sativus. **Bitter vetch.**

11198. Lathyrus sativus. **Bitter vetch.**

Received from C. C. Morse & Co., Santa Clara, Cal.

11199. Lathyrus sativus. **Bitter vetch.**

From Agricultural Experiment Station, Berkeley, Cal.

11200. Lathyrus tingitanus. **Tangier scarlet pea.**

From C. C. Morse & Co., Santa Clara, Cal.

11201. Lespedeza striata. **Japan clover.**

11202. Lolium italicum. **Italian rye-grass.**

11203. Lolium perenne. **Perennial rye-grass.**

11204. Lotus corniculatus. **Bird's-foot trefoil.**

11129 to 11236—Continued.

11205. Lupinus affinis. **Blue lupine.**

11206. Lupinus angustifolius. **Blue lupine.**

11207. Lupinus luteus. **Yellow lupine.**

11208. Medicago denticulata. **Bur clover.**

11209. Medicago sativa. **Alfalfa.**

11210. Medicago sativa. **Alfalfa.**

11211. Medicago sativa. **Alfalfa.**

Turkestan. From Henry Nungesser & Co., New York, N. Y.

11212. Melilotus alba. **Sweet, or Bokhara, clover.**

11213. Mucuna utilis. **Velvet bean.**

11214. Pennisetum typhoideum. **Pearl millet.**

11215. Phleum pratense. **Timothy.**

11216. Pisum arvense. **Canada field pea.**

11217. Poa pratensis. **Kentucky bluegrass.**

11218. Secale cereale. **Rye.**

11219. Secale cereale. **Rye.**

Winter.

11220. Chaetochloa italica. **Hungarian grass.**

11221. Trifolium alexandrinum. **Berseem.**

From C. C. Morse & Co., Santa Clara, Cal.

11222. Trifolium hybridum. **Alsike.**

11223. Trifolium incarnatum. **Crimson clover.**

11224. Trifolium pratense. **Red clover.**

11225. Trifolium repens. **White clover.**

11226 to 11229. Triticum vulgare. **Wheat.**

11226. *Zimmerman.* **11228.** *Preston* (Spring).
11227. *Budapest.* **11229.** *Turkey.*

From the Agricultural Experiment Station, Manhattan, Kans.

11230. Vicia bithynica.

11231. Vicia fulgens. **Scarlet vetch.**

11232. Vicia narbonnensis. **Narbonne vetch.**

11233. Vicia sativa. **Common vetch.**

11234. Vicia villosa. **Hairy vetch.**

11235. Vicia villosa. **Hairy vetch.**

Inoculated April 16, 1904.

11236. Vigna sinensis. **Cowpea.**

Warren. From Professor Newman, Agricultural Experiment Station, Fayetteville, Ark.

11237 to 11251. Beta vulgaris. **Sugar beet.**

Seed from 1903 crop remaining on hand July 1, 1904, after the distribution made by Mr. J. E. W. Tracy. Previous distribution recorded under these numbers.

11237. *Kleinwanzleben.*

From Klein Wanzleben Sugar Company, Klein Wanzleben, Germany. (Tracy's No. 12853.)

11238. *Schreiber's Specialität.*

From G. Schreiber & Sons, Nordhausen, Germany. (Tracy's No. 12854.)

11237 to 11251—Continued.

11239. From Lehi Sugar Company, Lehi, Utah. (Tracy's No. 12856.)

11240. *Elite Kleinwanzleben.*
From the Empire Sugar Company, Lyons, N. Y. Originally from Dippe Brothers, Quedlinburg, Germany. (Tracy's No. 12857.)

11241. *Kleinwanzleben.*
From the Empire Sugar Company, Lyons, N. Y. Originally from Kuhn & Co., Naarden, Holland. (Tracy's No. 12858.)

11242. *Kleinwanzleben.*
From the Empire Sugar Company, Lyons, N. Y. Originally from F. Heine, Hadmersleben, Germany. (Tracy's No. 12859.)

11243. *Kleinwanzleben.*
From the American Beet Sugar Company, Grand Island, Nebr. (Tracy's No. 12860.)

11244. *Kleinwanzleben.*
From the Sanilac Sugar Refining Company, Croswell, Mich. Originally from Orro Hoerning, Eisleben, Germany. (Tracy's No. 12862.)

11245. *Kleinwanzleben.*
From the Sanilac Sugar Refining Company, Croswell, Mich. Originally from Henry Mette, Quedlinburg, Germany. (Tracy's No. 12863.)

11246. *Jaensch Victrix.*
From the Sanilac Sugar Refining Company, Croswell, Mich. Originally from Gustav Jaensch, Aschersleben, Germany. (Tracy's No. 12864.)

11247. *Knauer's Mangold.*
From the Sanilac Sugar Refining Company, Croswell, Mich. Originally from M. Knauer, Grobers, Germany. (Tracy's No. 12765.)

11248. *Aderstadt.*
From the Sanilac Sugar Refining Company, Croswell, Mich. Originally from M. Knauer, Grobers, Germany. (Tracy's No. 12866.)

11249. *Kleinwanzleben.*
From the Menominee River Sugar Refining Company, Menominee, Mich. Originally from the Klein Wanzleben Sugar Factory, Klein Wanzleben, Germany. (Tracy's No. 12867.)

11250. *Elite Kleinwanzleben.*
From the Menominee River Sugar Refining Company, Menominee, Mich. Originally from Otto Bruenstedt, Schladenam-Hartz, Germany. (Tracy's No. 12868.)

11251. *Elite Kleinwanzleben.*
From Menominee River Sugar Refining Company, Menominee, Mich. Originally from C. Braune, Biendorf, Germany. (Tracy's No. 12869.)

11252 to 11258.

Plants and seeds presented to or secured by Mr. P. H. Dorsett for planting at the Plant Introduction Garden, Chico, Cal.

11252. JUGLANS CALIFORNICA × QUERCUS (?).

Presented by Mr. S. M. Desher, Garden Grove, Cal.

"This is one of a number of trees from a planting made for grafting stock about two years ago." (*Dorsett.*)

11253. JUGLANS NIGRA. **Black walnut.**

Nuts from Mr. Ewing D. Johnson's farm, near Rockbridge, southeast of Columbia, Mo.

11254. HICORIA sp. **Hickory.**

Small hickory nuts from Mr. Ewing D. Johnson's farm, near Rockbridge, southeast of Columbia, Mo. Secured in February, 1904.

11255. AMYGDALUS hyb. **Peach almond.**

Seeds from G. W. H. fruit ranch. Received October 22, 1903.

11252 to 11258—Continued.

11256. Hicoria sp. **Hickory.**

Large hickory nuts from Wolfskill Ranch, Yolo County, Cal. Received October 10, 1903.

11257. Juglans cinerea. **Butternut.**

Nuts from Wolfskill Ranch, Yolo County, Cal. Received October 25, 1903.

11258. Cedrus libani. **Cedar of Lebanon.**

Seed from an avenue of trees near Pasadena, Cal. Presented by Mr. C. R. Lukins, Pasadena, Cal.

11259 to 11262.

From Hacienda "La Trinidad," Arcelia, Guerrero, Mexico. Presented by Mr. Federico Chisolm. Received June 24, 1904.

A collection of unidentified Mexican bulbs.

11263. Gossypium herbaceum. **Cotton.**

From Valetta, Malta. Presented by Dr. Giovanni Borg. Received June 20, 1904.

Maltese. "Seed of the old Maltese cotton, which, according to Doctor Borg, has been cultivated in Malta since the times of the Phoenicians, three thousand years ago. This is an early-ripening sort, maturing its bolls in August or September. It is a very hardy sort, of low habit, and flowers and sets with bolls when quite young. Doctor Borg says it should be sown rather thick and that it is a very productive sort. The fiber is rather short, altho very strong and elastic. Introduced as of possible use in the experiments against the boll weevil because of its early-ripening habit." (*Fairchild.*)

11264 to 11268.

From Geneva, Idaho. Received thru Mr. F. W. Boehme, June 23, 1904.

A collection of grains adapted to high altitudes, as follows:

11264. Hordeum vulgare. **Barley.**

Beardless.

11265. Hordeum vulgare. **Barley.**

Beardless and hull-less.

11266. Triticum vulgare. **Wheat.**

Spring wheat.

11267. Linum usitatissimum. **Flax.**

11268. Secale cereale. **Rye.**

Spring rye.

11269. Hyphaene crinita. **Doum palm.**

From Upper Egypt. Received thru Mr. T. H. Kearney, June 15, 1904.

"Botanically this is one of the most interesting palms in the world, as, unlike almost all others, it has a branching stem. It is suited to a frostless and exceptionally dry region and may succeed in the warmest and driest portions of this country. The fruits, which are produced in large clusters, are used for food by the poorer classes, the part eaten being the fibrous, mealy husk, which tastes something like gingerbread, and for this reason is called the "gingerbread tree" of Egypt. A drink called "coca" is also made from this fibrous husk and the large, yellowish brown, beautifully polished fruits of this palm." (*Kearney.*)

11270 to 11274.

From Jalapa, Mexico. Presented by Mr. Frank N. Meyer to Mr. G. W. Oliver. Received June 23, 1904.

Seeds of five wild Mexican plants, mostly unidentified.

11275. MEDICAGO SATIVA. **Alfalfa.**

From Chicago, Ill. Received thru the Albert Dickinson Company, June 28, 1904. (Ordered by sample "Cabin.")

11276. TRIFOLIUM REPENS. **White clover.**

From Chicago, Ill. Received thru the Albert Dickinson Company, June 28, 1904. (Ordered by sample "Boil.")

11277 to 11341. PHOENIX DACTYLIFERA. **Date.**

From Orléansville, Algeria. Received thru Yahia ben Kassem, July 5, 1904. Sixty-five date palms, all from the Mzab oasis.

11277. *Deglet Noor.*
11278. *Deglet Noor.*
11279. *Deglet Noor.*
11280. *Rhars.*
11281. *Rhars.*
11282. *Rhars.*
11283. *Hamraya.*
11284. *Hamraya.*
11285. *Hamraya.*
11286. *Tadala.*
11287. *Tadala.*
11288. *Tadala.*
11289. *Tadala.*
11290. *Tadala.*
11291. *Tadala.*
11292. *Tadala.*
11293. *Tadala* (?).
11294. *Bent Kebala.*
11295. *Bent Kebala.*
11296. *Bent Kebala.*
11297. *Bent Kebala.*
11298. *Bent Kebala.*
11299. *Bent Kebala.*
11300. *Bent Kebala.*
11301. *Bent Kebala.*
11302. *A' Ooshet.*
11303. *A' Ooshet.*
11304. *A' Ooshet.*
11305. *Kseba.*
11306. *Kseba.*
11307. *Kseba.*
11308. *Kerboosh.*
11309. *Kerboosh.*
11310. *Kerboosh.*
11311. *Kerboosh.*
11312. *Tafazween.*
11313. *Tafazween.*
11314. *Tafazween.*
11315. *Timjoohert.*
11316. *Timjoohert.*
11317. *Timjoohert.*
11318. *Timjoohert.*
11319. *Timjoohert.*
11320. *Timjoohert.*
11321. *Timjoohert.*
11322. *Timjoohert.*
11323. *Timjoohert.*
11324. *Timjoohert.*
11325. *Timjoohert.*
11326. *Tamzoohart.*
11327. *Tamzoohart.*
11328. *Taoorarhet.*
11329. *Taoorarhet.*
11330. *Taoorarhet.*
11331. *Lazerza.*
11332. *Tazeza' oot.*
11333. *Tazeza' oot.*
11334. *Tazeza' oot.*
11335. *Toojat.*
11336. *Toojat.*
11337. *Toojat.*
11338. *Sebaa Loosif.*
11339. *Sebaa Loosif.*
11340. (No label.)
11341. *Tazaga' at.*

11342. NEPHELIUM LITCHI. **Litchi.**

From Trinidad, British West Indies. Received July 2, 1904.

11343. GOSSYPIUM BARBADENSE. **Cotton.**

From Valetta, Malta. Presented by Dr. Giovanni Borg. Received July 5, 1904.

"An Egyptian variety which Doctor Borg has been trying to improve on the island of Malta. Introduced for the experiments in connection with the boll weevil." (*Fairchild.*)

11344. VIGNA SINENSIS. **Cowpea.**

From West Branch, Mich. Received thru Edw. E. Evans Seed Company, July 8, 1904.

Michigan Favorite. Said by Mr. Evans to be the earliest sort known; ripens seed every year in Michigan.

11345 to 11353.

From Guerrero, Mexico. Received thru Mr. Federico Chisolm, July 9, 1904.

Native Mexican bulbs, not identified.

11354. COFFEA sp. **Coffee.**

From Abyssinia, Africa. Presented by Hon. Robert P. Skinner, American consul-general at Marseille, France. Received July 11, 1904.

Harrar. Probably a wild variety from Abyssinia.

11355 to 11368. BETA VULGARIS. **Sugar beet.**

Seed from 1903 crop remaining on hand July 1, 1904, after the distribution made by Mr. J. E. W. Tracy. Previous distribution recorded under these numbers.

11355. *Schreiber's Specialität.*

From the Menominee Sugar Refining Company, Menominee, Mich. Originally from G. Schreiber & Sons, Nordhausen, Germany. (Tracy's No. 12870.)

11356. *Kleinwanzleben.*

From H. C. & J. B. Agnew, Agnew, Cal. (Tracy's No. 12871.)

11357. *Kleinwanzleben.*

From Metz & Co., Streglitz, near Berlin, Germany.

11358. From M. Knauer, Grobers, Germany. Marked 7300.

11359. From M. Knauer, Grobers, Germany. Marked 7301.

11360. *Kleinwanzleben.*

From Carl Schobert & Co.

11361. *Elite Kleinwanzleben.*

From G. Schreiber & Sons, Nordhausen, Germany.

11362. *Kleinwanzleben.*

From E. H. Morrison, Fairfield, Wash. Purchased in 1902 for the Congressional seed distribution.

11363. *Kleinwanzleben.*

From E. H. Morrison, Fairfield, Wash. (Tracy's No. 12855.)

11364. *Kleinwanzleben.*

From C. C. Morse & Co., Santa Clara, Cal. (Tracy's No. 12861.)

11365. (Tracy's No. 12844.)

11366. (Tracy's No. 12847.)

11367. (Tracy's No. 12849.)

11368. (Tracy's No. 12850.)

11369. MANGIFERA INDICA. **Mango.**

From the Government Botanic Gardens, Seharunpur, India. Presented by Mr. Robert Anderson, Lansdowne, Pa., for propagation. Received February 25, 1904.

Buds of the *Langra* mango.

11370 and 11371.

Seed on hand July 1, 1904, numbered for convenience of recording distribution.

11370. VIGNA SINENSIS. **Cowpea.**

Iron. From Mr. T. S. Williams, Monetta, S. C.

11371. ANDROPOGON SORGHUM. **Sorghum.**

Early Amber. From Mr. Seth Kenney, Morristown, Minn.

11372 to 11477. VITIS sp. **Grape.**

From Thomery, France. Received thru E. Salomon & Sons, and shipped direct to Niles, Cal.

11372. *Rupestris Martin.*

11373. *Riparia Grand Glabre × Aramon-Rupestris 4110.*

11374. *Pinot × Rupestris 1305.*

11375. *Rupestris de Semis 81–2.*

11376. *Mourvedre × Rupestris 1202.*

11377. *Riparia France.*

11378. *Rupestris × Berlandieri 301–37–152.*

11379. *Monticola × Riparia 18804.*

11380. *Monticola × Riparia 18815.*

11381. *Chasselas × Berlandieri 41 B.*

11382. *Cabernet × Rupestris Ganzin 33 A.*

11383. *Bourisquou × Rupestris 4306.*

11384. *Monticola × Riparia 18808.*

11385. *Rupestris × Berlandieri 301 A.*

11386. *Riparia × Rupestris-Aramon-Jaeger 201.*

11387. *Riparia × Berlandieri 161–49.*

11388. *Riparia × Rupestris 3306.*

11389. *Viala.*

11390. *Bourisquou × Rupestris 3907.*

11391. *Berlandieri × Riparia 420 A.*

11392. *Rupestris × Berlandieri 219 A.*

11393. *Bourisquou × Rupestris 109–4.*

11394. *Bourisquou × Rupestris 4308.*

11395. *Viala × Riparia.*

11396. *Berlandieri × Riparia 420 B.*

11397. *Rupestris × Riparia 1615.*

11398. *Riparia du Colorado.*

11399. *Riparia × Rupestris 101–14.*

11400. *Berlandieri × Riparia 33 E. M.*

11401. *Rupestris × Riparia 108–16.*

11372 to 11477—Continued.

11402. *Berlandieri Lafont No. 9.*
11403. *Alicante Bouschet × Riparia 141 A.*
11404. *Aramon × Rupestris Ganzin 9.*
11405. *Aestivalis-Calicola × Riparia-Rupestris 554–5.*
11406. *Berlandieri No. 1.*
11407. *Berlandieri No. 2.*
11408. *Berlandieri × Riparia 157–11.*

The following vines were received at Niles, April 11, 1904:

11409. *Cordifolia × Riparia 127–1 (?).*
11410. *Rupestris × Cinerea.*
11411. *Rupestris × Cordifolia 107–11.*
11412. *Rupestris × Hybrid Azemar 215.*
11413. *York × Rupestris Ganzin 202.*
11414. *York × Rupestris Ganzin 212.*

The following cuttings were received at Niles, March 22, 1904:

11415. *Pinot × Rupestris 1305.*
11416. *Rupestris Othello.*
11417. *Riparia × Rupestris-Aramon-Jaeger 201.*
11418. *Riparia × Berlandieri 161–49.*
11419. *Monticola × Riparia 18804.*
11420. *Chasselas × Rupestris 901.*
11421. *Columbaud × Riparia 2502.*
11422. *Riparia Grand Glabre × Aramon-Rupestris 4110.*
11423. *Rupestris × Riparia 1615.*
11424. *Pinot Bouschet × Riparia 3001.*
11425. *Rupestris × Petit Bouschet-Jaeger 504.*
11426. *Berlandieri × Riparia 34 E. M.*
11427. *Mourvedre × Rupestris 1202.*
11428. *Berlandieri × Riparia 33 E. M.*
11429. *Berlandieri × Riparia 420 A.*
11430. *Bourisquou × Rupestris 603.*
11431. *Berlandieri × Riparia 420 B.*
11432. *Riparia × Cordifolia-Rupestris 106–8.*
11433. *Tisserand.*
11434. *Riparia France.*
11435. *Monticola × Riparia 18815.*
11436. *Cabernet × Rupestris Ganzin 33 A.*
11437. *Riparia × Rupestris 3306.*
11438. *Riparia Martineau.*
11439. *Riparia × Rupestris Ramon.*
11440. *Rupestris Martin.*
11441. *Aramon × Riparia 143 A.*
11442. *Riparia × Rupestris 101–14.*
11443. *Rupestris × Berlandieri 301 A.*

11372 to 11477—Continued.

11444. *Carignane × Rupestris 504.*

11445. *Rupestris × Riparia 108–16.*

11446. *Rupestris de Semis 81–2.*

11447. *Aestivalis-Calicola × Riparia-Rupestris 554–5.*

11448. *Monticola × Riparia 18808.*

11449. *Aramon × Rupestris Ganzin 9.*

11450. *Berlandieri No. 2.*

11451. *Berlandieri × Riparia 157–11.*

11452. *Berlandieri Lafont No. 9.*

11453. *Riparia × Rupestris 101.*

11454. *Carignane × Rupestris 501.*

11455. *Rupestris × Berlandieri 301–37–152.*

11456. *Riparia × Rupestris 3309.*

11457. *Riparia × Rupestris de Jaeger.*

11458. *Viala × Riparia.*

11459. *Rupestris Mission.*

11460. (Unidentified.)

The following cuttings were received at Niles, April 11, 1904:

11461. *Bourisquou × Rupestris 109–4.*

11462. *Bourisquou × Rupestris 603.*

11463. *Carignane × Rupestris 504.*

11464. *Rupestris × Cordifolia 107–11.*

11465. *Rupestris × Hybrid Azemar 215.*

11466. *Alicante Bouschet × Cordifolia 142 B.*

11467. *Aestivalis-Rupestris × Riparia 227.*

11468. *Cordifolia × Rupestris.*

11469. *Rupestris × Berlandieri 301 B.*

11470. *Bourisquou × Rupestris 4306.*

11471. *Bourisquou × Rupestris 4308.*

11472. *Carignane × Rupestris 501.*

11473. *Calicola × Aestivalis 13205.*

11474. *York × Rupestris Ganzin.*

11475. (Unidentified.)

11476. *Cinerea-Rupestris × Riparia 229.*

11477. (Unidentified.)

11478. GARCINIA MORELLA. **Gamboge.**

From Castleton Gardens, Jamaica. Received July 18, 1904.

11479. LESPEDEZA STRIATA. **Japan clover.**

From Augusta, Ga. Received thru the N. L. Willet Drug Company, July 19, 1904.

11480. EUCHLAENA MEXICANA. **Teosinte.**

From Richmond, Va. Received thru T. W. Wood & Sons, July 20, 1904.

11481. Lolium perenne. **English rye-grass.**

From New York, N. Y. Received thru Henry Nungesser & Co., July 20, 1904.

11482. Festuca pratensis. **Meadow fescue.**

From New York, N. Y. Received thru Henry Nungesser & Co., July 20, 1904.

11483 and 11484.

From Ghent, Belgium. Received thru Mr. Louis Van Houtte, père, July 22, 1904.

11483. Garcinia livingstonei.

11484. Lansium sumatrana.

11485 to 11489. Phoenix dactylifera. **Date.**

From Fayum, Egypt. Received thru Mr. H. A. Rankin, July 26, 1904.

11485. *Saydy.*

11486. *Gaggar.*

11487. *Sultany.*

11488. *Frakhee.*

11489. *Saydy* (male)

"These date offshoots were wrapt in palm fiber (*lif*) and held in place by cords. They were rather dry, but in general in fairly good condition. Most of the offshoots were small, some not weighing over 10 pounds and only some half dozen weighing over 50 pounds. However, considering the inaccessibility of the region, we ought to be glad to get almost any kind of an offshoot that will grow. I noticed that the variety *Saydeh* has a large number of small offshoots attached to the sides of those sent, altho, as I stated above, the offshoots are only of medium size, averaging probably 30 to 40 pounds in weight. The collection of *Fraakhee* consisted of one very large offshoot and three very small ones. The very large offshoot showed a remarkable peculiarity in that the palm fiber, or '*lif*,' was still intact, forming a cardboard-like tissue, especially on the right-hand border. If this peculiarity of the interpetiolar sheets of fiber appears constant, this variety will have a very clear distinguishing mark." (*Swingle.*)

11490. Vitis rhombifolia. **Grape.**

Received from the United States Botanical Gardens, Washington, D. C., in 1901. Plants originally came from the Botanic Garden in Glasgow.

11491. Vitis gongylodes. **Grape.**

From St. Louis, Mo. Presented by Dr. William Trelease, superintendent of the Missouri Botanic Garden, to Dr. B. T. Galloway, in 1902.

11492. Vitis sp. **Grape.**

From Mexico. Received thru Dr. J. N. Rose, of the United States National Museum, in 1902. (Rose No. 286.)

11493. Vitis sp. **Grape.**

From Mexico. Received thru Dr. J. N. Rose, of the United States National Museum, in 1902. (Rose No. 749.)

11494. Phleum pratense. **Timothy.**

From Toledo, Ohio. Received thru W. D. Morehouse & Co., July 26, 1904.

11495. Panicum miliaceum. **Broom-corn millet.**

From Cincinnati, Ohio. Received thru J. M. McCullough's Sons, July 27, 1904.

11496. CHAETOCHLOA ITALICA. **German millet.**

From Chicago, Ill. Received thru the Albert Dickinson Company, July 27, 1904.

"Pellet" sample.

11497. NICOTIANA TABACUM. **Tobacco.**

From Cavala, Turkey. Presented by Mr. N. J. Pantelides, of Chios Island, Turkey. Received July 5, 1904.

"Seed of the famous Cavala tobacco, which forms one of the most important elements used in the blending of the cigarette filler of the famous Egyptian cigarettes. According to Mr. Pantelides's letter of June 18, 1904, this seed was sent him by the governor of Cavala and is no doubt authentic and of first quality. Mr. Pantelides further remarks that the cultivation and harvesting of the Cavala tobacco require great experience. From the same plant one can pick leaves of a value of only 0.50 of a franc per kilogram and of a value of 15 to 20 francs a kilogram. The lance-shaped leaves found at the summit of the plant have a very fine aroma, and it is for this fine aroma that such high prices are paid. If during the process of picking the terminal bud is injured, the fine aroma of the leaves is lost and the leaves lose their value. The processes of drying and fermentation are those which give to the leaves their fine color and excellent flavor. The Ottoman Regie pays from one to two thousand francs monthly salary to good clarifiers (clarificateurs) and 250 to 300 francs a month to good cultivators. In his country Mr. Pantelides says the seed is sown in January, transplanted during February to a place protected from the cold, and in March transplanted again to permanent locations. Each plant is set out a meter each way from its neighbors. The best soil for the culture of this tobacco is said to be a red one mixt with stones of iron pyrites, and the best locations are those on the eastern slopes of hills." (*Fairchild.*)

11498. NICOTIANA TABACUM. **Tobacco.**

From Sao Paulo, Brazil. Received thru Dr. Horace M. Lane, president of the Mackenzie College, July 25, 1904.

Bahiano tobacco seed, the variety from which the celebrated *Bahia* leaf is made.

11499. PRUNUS VIRGINIANA. **Chokecherry.**

"From Arden, near Dakota-Montana line. Presented by Prof. J. W. Blankinship, of the Montana Agricultural Experiment Station, Bozeman, Mont. Received August 1, 1904.

"Seeds of a free-flowering shrubby species of chokecherry which is perfectly hardy when the thermometer drops to −30° F. in winter. From the description given by Professor Blankinship this must be a very showy plant in spring. The black fruits are used for jam or 'cherry butter' making." (*Fairchild.*)

"A beautiful flowering tree, about 25 feet high." (*Blankinship.*)

11500. PRUNUS VIRGINIANA. **Chokecherry.**

From Bozeman, Mont. Presented by Prof. J. W. Blankinship. Received August 1, 1904.

"Seeds of a large, red-fruited variety, whose fruits are considered better than the black. Large quantities of cherry butter are made in Montana, and this variety has possibilities for the breeder." (*Fairchild.*)

11501. GARCINIA INDICA.

From Trinidad, West Indies. Received thru Mr. J. H. Hart, superintendent of the Botanic Gardens, July 29, 1904.

11502. GOSSYPIUM sp. **Cotton.**

From San Luis Soyatlan, Jalisco, Mexico. Received thru Señor Hilario Cuevas, July 21, 1904.

Cotton harvested in June from trees planted in September preceding at an altitude of 1,630 meters above the level of the sea. Sent at the request of Mr. L. H. Dewey.

11503. Mucuna utilis. **Velvet bean.**

From Clarcona, Fla. Received thru Mr. H. Meislahn, August 3, 1904.

11504. Coffea sp. **Coffee.**

From Abyssinia. Received thru Hon. Robert P. Skinner, United States consul-general at Marseille, France, July 22, 1904.

Wild *Harrar* coffee.

11505 to 11531.

From London, England. Received thru James Veitch & Sons (Limited), April, 1904.

A collection of plants, as follows:

11505. Rubus australis.

11506. Rubus biflorus.

11507. Rubus odoratus. **Purple flowering raspberry.**

11508. Rubus rosaefolius. **Strawberry raspberry.**

11509. Rubus phoenicolasius. **Wineberry.**

11510. Rubus nigrobaccus. **Blackberry.**

Snyder.

11511. Rubus spectabilis. **Salmon berry.**

11512. Rubus deliciosus. **Rocky Mountain flowering raspberry.**

11513. Rubus leucodermis. **Western black raspberry.**

11514. Rubus occidentalis. **Black raspberry.**

Newman's Thornless.

11515. Rubus nigrobaccus. **Blackberry.**

11516. Rubus hyb. **Raspberry-blackberry hyb.**

The Mahdi.

11517 and 11518. Rosa spp. **Rose.**

11517. *Alice Grahame.*

11518. *Bessie Brown.*

11519. Rosa humilis. **Pasture rose.**

11520 to 11531. Rosa spp. **Rose.**

11520. *Edith D'Ombrain.*

11521. *Florence Pemberton.*

11522. *Lady Moyra Beauclerc.*

11523. *Madame Antoine Mari.*

11524. *Marianne Pfitzer.*

11525. *Marie Lavälley.*

11526. *Mildred Grant.*

11527. *Morning Glow.*

11528. *Mrs. Allen Chandler.*

11529. *Mrs. Benjamin R. Cant.*

11530. *Queen of Sweden and Norway.*

11531. *Salmonea.*

11532. Arachis hypogaea. **Peanut.**

From Sao Paulo, Brazil. Received thru Dr. Horace M. Lane, president of the Mackenzie College, July 16, 1904.

Pods of a peanut, said to be native, but which Doctor Lane thinks may be of African origin. The pods are of fair size and nearly all contain two seeds.

11533. Polianthes longiflora. **Tuberose.**

From Mexico. Received thru Dr. J. N. Rose, of the United States National Museum, August 5, 1904.

11534. ACHRAS SAPOTA. **Sapodilla.**

Plants propagated from large tree in Department conservatory; numbered for convenience in recording future distribution, August 1, 1904.

11535. RICHARDIA AFRICANA. **Calla.**

From Chicago, Ill. Received thru Vaughan's seed store, August 10, 1904.

Trade name, *Calla Aethiopica devoniensis.*

11536 to 11538. ROSA sp. **Rose.**

From London, England. Received thru Barr & Sons, June, 1903.

11536. *Austrian Copper Brier.*
11537. *Harisoni Brier.*
11538. *Persian Yellow Brier.*

11539 to 11564.

From Feltham, Middlesex, England. Received thru Mr. Thomas S. Ware, Hale Farm Nurseries, August, 1903.

Plants, as follows:

11539 to 11563. CLEMATIS spp. **Clematis.**

11539. *Madame Édouard André.*
11540. *Grace Darling.*
11541. *Alexandra.*
11542. *Anderson Henryi.*
11543. *Ascontiensis.*
11544. *Beauty of Worcester.*
11545. *Duchess of Edinburgh.*
11546. *Duke of Edinburgh.*
11547. *Earl of Beaconsfield.*
11548. *Enchantress.*
11549. *Nellie Moser.*
11550. *Fairy Queen.*
11551. *Fair Rosamond.*
11552. CLEMATIS FORTUNEI.
11553. *Gem.*
11554. *Gipsey Queen.*
11555. *Gloire de St. Julien.*
11556. *Grand Duchess.*
11557. CLEMATIS RETICULATA.
11558. CLEMATIS JACKMANNI ALBA.
11559. CLEMATIS JACKMANNI.
Snow White.
11560. CLEMATIS JACKMANNI.
Superba.
11561. *John Gould.*
11562. *Lawsoniana.*
11563. *Marcel Moser.*

11564. AMPELOPSIS VEITCHII PURPUREA.

11565 to 11589. LILIUM spp. **Lily.**

From Yokohama, Japan. Received thru Suzuki & Iida, New York agents for the Yokohama Nursery Company, December, 1903.

Bulbs as follows:

11565. LILIUM BATMANNIAE.
11566. LILIUM CONCOLOR.
11567. LILIUM CONCOLOR OHIME.
11568. LILIUM CONCOLOR.
11569. LILIUM CONCOLOR OKIHIME.
11570. LILIUM CORDIFOLIUM.
11571. LILIUM ELEGANS.
11572. LILIUM ELEGANS.
11573. LILIUM ELEGANS ATROSANGUINEUM.
11574. LILIUM ELEGANS SEMIPLENO.

11565 to 11589—Continued.

11575. Lilium elegans incomparable.

11576. Lilium dahuricum.

11577. Lilium hansoni.

11578. Lilium japonicum.

11579. Lilium rubellum.

11580. Lilium brownii.

11581. Lilium leichtlinii.

11582. Lilium longiflorum.

11583. Lilium longiflorum eximium giganteum.

11584. Lilium medeoloides.

11585. Lilium speciosum rubrum.

11586. Lilium speciosum album.

11587. Lilium speciosum kretzeri.

11588. Lilium speciosum melpomene.

11589. Lilium ukeyuri.

11590 and 11591. Lilium longiflorum eximium giganteum. **Lily.**

Grown from S. P. I. No. 11583 in the Department greenhouse.

11590. Bulbs.

11591. Seeds.

11592 to 11602.

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, July 11, 1904.

Small lots of seeds of Guerrero plants, as follows:

11592. Enterolobium cyclocarpum. **"Parota."**

"One of the most admirable shade trees I have ever seen, a rapid grower, and valuable for the easily worked but durable lumber it yields, as well as for the seeds, which are largely eaten by the natives at this season and are greedily eaten by hogs. The measurements of a specimen shading the assay office at 'La Trinidad' were about as follows: Trunk, from ground to branches, 12 feet; diameter, 4 feet; from ground to top of tree, 59 feet; extreme spread of branches from tip to tip, measured thru trunk, 122 feet; the general outline similar to that of an umbrella. To me it seems a tree well worth introducing." (*Chisolm.*)

11593 to 11602.

A collection of unidentified plants, mostly bulbs.

11603 to 11623.

From Fort Hays, Kans. Received thru Mr. J. G. Haney, superintendent of the Branch Agricultural Experiment Station, August 1, 1904.

11603 to 11617. Triticum vulgare. **Wheat.**

11603. *Kharkof.* Grown from S. P. I. No. 7786.

11604. *Beloglina.* Grown from S. P. I. No. 7787.

11605. *Ulta.* Grown from S. P. I. No. 5638.

11606. *Crimean.* Grown from S. P. I. No. 5636.

11607. *Ghirka Winter.* Grown from S. P. I. No. 5637.

11608. *Padui.* Grown from S. P. I. No. 7466.

11609. *Kharkof.* Grown from S. P. I. No. 5641.

11610. *Turkey.* Grown from C. I. No. 1558.

11611. *Crimean.* Grown from S. P. I. No. 5635.

11612. *Crimean.* Grown from C. I. No. 1559.

11613. *Banat.* Grown from S. P. I. No. 5496.

11614. *Bacska.* Grown from S. P. I. No. 5498.

11615. *Weissenburg.* Grown from S. P. I. No. 5499.

11616. *Pesterboden.* Grown from S. P. I. No. 5500.

11617. *Kharkof.* Grown from S. P. I. No. 7467.

11603 to 11623—Continued.

11618 and 11619. TRITICUM DURUM. **Macaroni wheat.**

11618. *Kubanka.* Grown from S. P. I. No. 9478.

11619. *Velvet Don.* Grown from S. P. I. No. 9479.

11620 to 11623. HORDEUM spp. **Barley.**

11620. HORDEUM VULGARE. **Barley.**
Black. Grown from S. P. I. No. 7970.

11621. HORDEUM VULGARE. **Barley.**
White. Grown from S. P. I. No. 7969.

11622. HORDEUM DISTICHUM NUTANS. **Two-row barley.**
Hanna. Grown from S. P. I. No. 9133.

11623. HORDEUM TETRASTICHUM. **Four-row barley.**
Tetcherit. Grown from S. P. I. No. 7796.

11624. CERCIDIPHYLLUM JAPONICUM.

From Philadelphia, Pa. Received thru Thomas Meehan & Sons, 1903.

Plants purchased to test as stocks for the mango. The scions failed to unite.

11625. MANGIFERA INDICA. **Mango.**

From Tahiti. Received thru Captain Rennie, of the steamship *Mariposa*, August 11, 1904.

11626 and 11627. (Undetermined.)

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, August 13, 1904.

11628. HICORIA hyb. **Pecan.**

From Washington, D. C. Received thru Mr. P. H. Dorsett, February, 1904.

From pecans purchased in the open market. Has the appearance of a hybrid between *Hicoria pecan* and *Hicoria aquatica*. Planted in the Plant Introduction Garden at Chico, Cal., May 31, 1904.

11629. ACTINIDIA sp. **"Yang-taw."**

From the borders of Yunnan. Received thru Consul-General Wilcox, of Hankow, China, and Mr. Wilson, at the Plant Introduction Garden, Chico, Cal., July 8, 1904.

Fruit said to be very fine, has flavor of gooseberry, fig, and citron. Sometimes called "Yang-tao."

11630. ACTINIDIA sp. **"Yang-taw."**

From the borders of Yunnan. Received thru Consul-General Wilcox, of Hankow, China, and Mr. Wilson, at the Plant Introduction Garden, Chico, Cal., July 8, 1904.

Possibly distinct from No. 11629, tho as yet undetermined.

11631. ERIOBOTRYA JAPONICA. **Loquat.**

From Orange, Cal. Collected by Mr. M. Payan, of Olive, Cal., from the orchard of Mr. C. P. Taft, Orange, Cal. Received at the Plant Introduction Garden, Chico, Cal., July 18, 1904.

11632. ACHRAS SAPOTA (?). **Sapodilla.**

From Jalapa, Vera Cruz, Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

"A nice tasting fruit, in size and shape not unlike the eastern persimmon. The pulp is brownish and of a sweet, pleasant taste." (*Meyer.*)

11633. Prunus armeniaca. **Apricot.**

From Jalapa, Vera Cruz, Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

"These apricots are small in size but have sometimes a nice flavor. They seem to be all seedlings and vary, it is said, a great deal." (*Meyer.*)

11634. Cicer arietinum. **Chick-pea.**

From Jalapa, Vera Cruz, Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

"A vegetable which is eaten like green peas. On some markets they are sold roasted in the shell, and they taste well. Grown on dry but rich lands." (*Meyer.*)

11635. Fraxinus sp. **Ash.**

From Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

"A very handsome shade tree, which grows to quite a size. These seeds are from a very spreading variety which grew on dry, rocky places near Guadalajara." (*Meyer.*)

11636. Prunus sp. **Cherry.**

From Jalapa, Vera Cruz, Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

"This is a cherry inferior in size and flavor to the ordinary cherry. The tree is evergreen and can be used as an ornamental shade tree." (*Meyer.*)

11637. Lupinus sp. **Lupine.**

From Jalapa, Vera Cruz, Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

"A rather ornamental small lupine, with blue spikes, which vary in color from whitish to indigo blue." (*Meyer.*)

11638. Ricinus sp. **Castor-oil plant.**

From Jalapa, Vera Cruz, Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

"A castor-oil bean with very showy red spikes. May prove to be an ornamental plant." (*Meyer.*)

11639. Capsicum annuum. **Pepper.**

From Jalapa, Vera Cruz, Mexico. Received thru Mr. Frank N. Meyer at the Plant Introduction Garden at Chico, Cal., June, 1904.

Yellow Chili. "A handsome pepper, much sold in the market at Jalapa, a bright showy yellow, quite pungent in taste." (*Meyer.*)

11640. Agrostis alba. **Redtop.**

From New York, N. Y. Received thru Henry Nungesser & Co., August 16, 1904.

11641 to 11644.

From Nice, Alpes-Maritimes, France. Received thru Dr. A. Robertson-Proschowsky, August 1, 1904.

11641. Arundinaria simoni. **Bamboo.**

"A small bamboo, producing good, edible seeds. This small bamboo does not, as some others, die altogether after producing its seeds, but some rhizomes survive. Still perhaps it is too early to judge of the survival of such. As you will find, the large seeds are of very good taste, and evidently could be used

11641 to 11644—Continued.

as well as wheat, barley, and other grains. This bamboo is very resistant to drought. Would it eventually be a plant of any other than ornamental use? Perhaps some of your active and enterprising correspondents in the United States would care to try this plant." (*Proschowsky.*)

11642. JACARANDA OVALIFOLIA.

"The well-known tree of most striking beauty of foliage and flower. The timber is very strong. Resists well in dry places." (*Proschowsky.*)

11643. ALOË DICHOTOMA.

"Forms a picturesque tree of medicinal value." (*Proschowsky.*)

11644. PITTOSPORUM MACROPHYLLUM.

"This is a tree of very regular growth and striking beauty. Its leaves are nearly as large as those of *Magnolia grandiflora* L. But its chief merit consists in its beautiful creamy-white flowers, which exhale a perfume surpassing that of any other plant I know, even the orange and lemon. I should think that the extraction of this perfume would prove a paying undertaking." (*Proschowsky.*)

11645 and 11646. MANGIFERA spp.

From Saigon, Cochin China. Received thru Mr. M. E. Haffner, director of agriculture, August 20, 1904.

Seeds as follows:

11645. MANGIFERA CAMBODIANA.

11646. MANGIFERA MEKONGENSIS.

11647. MUSA sp. **Banana.**

From Monte, Grand Canary. Received thru Mr. Alaricus Delmard, August 22, 1904.

11648. MAMMEA AMERICANA. **Mammee apple.**

From Mayaguez, P. R. Received thru Mr. O. W. Barrett, Agricultural Experiment Station, August 22, 1904.

For use in mangosteen experiments.

11649. LILIUM NEILGHERRENSE. **Neilgherry lily.**

From Utakamand, India. Received thru Mr. G. H. Cave, superintendent of the Government Botanic Gardens, August 19, 1904.

11650. TRITICUM DICOCCUM. **Emmer.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., August 27, 1904.

Amidonnier noir.

11651 and 11652. MEDICAGO SATIVA. **Alfalfa.**

From City of Mexico, Mexico. Received thru Mr. Felix Foëx, National School of Agriculture, August 24, 1904.

11651. *Atlixco*, from State of Pueblo.

11652. *Apater*, from State of Guanajuato.

11653. CALOPHYLLUM CALABA.

From Honolulu, Hawaii. Received thru Mr. Gerrit P. Wilder, August 29, 1904.

For experiments in propagating the mangosteen.

11654. LANDOLPHIA sp. (?).

From Africa. Presented thru Mr. G. N. Collins by Mr. Gilbert Christy. Received August 31, 1904.

11655. AVENA SATIVA. **Oat.**

From Statesville, N. C. Received thru Dr. B. W. Kilgore, of the North Carolina Agricultural Experiment Station, September 2, 1904.

11656. THEOBROMA CACAO. **Cacao.**

From Nicoya, Costa Rica. Received thru Mr. G. N. Collins, June, 1903. (G. & G. No. 3979.)

11657. CASTILLOA NICOYENSIS. **Central American rubber.**

From Nicoya, Costa Rica. Received thru Mr. G. N. Collins, June, 1903. (G. & G. No. 3980.)

11658. HORDEUM VULGARE. **Barley.**

From Blacksburg, Va. Received thru Mr. John R. Fain, September 7, 1904.

Tennessee Winter barley, shipped from Jefferson City, Tenn.

11659. THEVETIA OVATA (?).

From Guadalajara, Mexico. Received from Mr. Federico Chisolm, September 3, 1904.

11660. HELIANTHUS sp. **Sunflower.**

From Bozeman, Mont. Received from the Montana Agricultural Experiment Station, August 29, 1904.

11661 to 11673. CITRUS DECUMANA. **Pomelo.**

From Calcutta, India. Originally from Mr. David Prain, of the Royal Botanic Garden. Presented to the Department by Mr. Henry Phipps, 6 East Eighty-seventh street, New York, N. Y. Received September 8, 1904.

Plants as follows:

11661. "Large White-Fleshed," from Seharunpur.

11662. "Large Red-Fleshed," from Seharunpur.

11663. "China," from Seharunpur.

11664. "Pure White Sweet," from Bangalore.

11665. "White Sweet," from Bangalore.

11666. "Red Sweet Variety," from Bangalore.

11667. "White Sour," from Bangalore.

11668. "Large," from Lucknow.

11669. "Small," from Lucknow.

11670. "White," from the Agricultural-Horticultural Society, Alipore, Calcutta, India.

11671. "A. H. Society's," from the Agricultural-Horticultural Society, Alipore, Calcutta, India.

11672. "Pink," from the Agricultural-Horticultural Society, Alipore, Calcutta, India.

11673. "Royal Botanic Garden" variety, from Calcutta.

11674. VITIS COIGNETIAE. **Crimson glory vine.**

From New York, N. Y. Received thru Messrs. Henry & Lee, 97 Water street, September 9, 1904.

11675. ANANAS SATIVUS. **Pineapple.**

Received September 9, 1904. (Mailed from some point in Liberia, but origin unknown.)

11676. BALSAMORRHIZA sp. **Balsam root.**

From Bozeman, Mont. Received thru Mr. A. J. Pieters, August, 1904.

11677. VICIA SATIVA. **Common vetch.**

From New York, N. Y. Received thru J. M. Thorburn & Co., 36 Cortlandt street, September, 1904.

11678. HORDEUM VULGARE. **Barley.**

From St. Anthony Park, Minn. Received thru Prof. W. M. Hays, of the Agricultural Experiment Station, September, 1904.

11679. VICIA SATIVA. **Common vetch.**

From Richmond, Va. Received thru T. W. Wood & Sons, September, 1904.

11680. VICIA VILLOSA. **Hairy vetch.**

From Richmond, Va. Received thru T. W. Wood & Sons, September, 1904.

11681. BRUCEA SUMATRANA. **"Kosam."**

From Singapore, Straits Settlements. Received from the Botanic Gardens, thru the German consulate, September 12, 1904.

The fruit of this plant is said to be an infallible remedy for dysentery.

11682. LIPPIA REPENS.

From Santa Barbara, Cal. Received thru Dr. F. Franceschi at the Plant Introduction Garden, Chico, Cal., August 26, 1904.

"Thrives in any soil, no matter how poor. Rapidly covers the ground with a very dense matting. Takes one-tenth as much water as any lawn; needs no mowing; will stand intense heat and several degrees of cold. Can be established in sloping ground." (*Franceschi.*) (See S. P. I. No. 4263.)

11683. HUMULUS LUPULUS. **Hop.**

From Wheatland, Cal. Received at the Plant Introduction Garden, Chico, Cal., August 15, 1904.

11684. BRASSICA NAPUS. **Rape.**

From New York, N. Y. Received thru Henry Nungesser & Co., September 15, 1904.

Dwarf Essex.

11685 to 11696.

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, September 19, 1904.

Miscellaneous seeds and bulbs, mostly unidentified.

11697. VICIA FABA. **Horse bean.**

From Ottawa, Canada. Received thru Graham Brothers, September 21, 1904.

Tick.

11698 to 11713. MANIHOT spp. **Cassava.**

From Sao Paulo, Brazil. Received thru Prof. Alberto Löfgren, director of the Botanic Gardens, September 24, 1904.

11698 to 11713—Continued.

Cuttings, as follows:

11698. *Globo.*
11699. *Vermelha do Pinhal.*
11700. *Boacava Brava.* (Poisonous.)
11701. *Tatu.*
11702. *Aipim Amarello.*
11703. *Vermelha.*
11704. *Branca.*
11705. *Mata Fome.*
11706. *Barra Bonita.*
11707. *Aipim Doce.*
11708. *Amarella.*
11709. *Cambalho Brava.*
11710. *Mata Fome II.*
11711. *Rosa.*
11712. *Sao Tedrinho.* (Very poisonous.)
11713. *Itapira Brava.* (Poisonous.)

11714. TRITICUM VULGARE. **Wheat.**

From Tempe, Ariz. Received thru Mr. John Jungerman, September 26, 1904.

Fretes. Grown from S. P. I. No. 7582.

11715. TRITICUM DURUM. **Macaroni wheat.**

From Tempe, Ariz. Received thru Mr. John Jungerman, September 26, 1904.

Marouani. Grown from S. P. I. No. 9324.

11716 and 11717. HORDEUM TETRASTICHUM. **Four-row barley.**

From Tempe, Ariz. Received thru Mr. John Jungerman, September 26, 1904.

11716. *Beldi.* Grown from S. P. I. No. 7583.
11717. *Telli.* Grown from S. P. I. No. 7584.

11718 and 11719. LIATRIS SCARIOSA. **Button snakeroot.**

From Minneapolis, Minn. Presented by Prof. E. M. Freeman. Received September 22, 1904.

11718. Roots or corms.
11719. Seed.

11720. SICANA ODORIFERA.

From Trinidad, British West Indies. Presented by Mr. J. H. Hart, superintendent of the Royal Botanic Gardens. Received September 20, 1904.

11721. GARCINIA CELEBICA.

From Buitenzorg, Java, Dutch East Indies. Presented by Doctor Treub, September 28, 1904.

11722. AVENA SATIVA. **Oat.**

From Yancey, Ga. Purchased from Mr. H. Yancey, jr. Received September 28, 1904.

Appler Rustproof.

11723. IPOMOEA PES-CAPRAE.

From Durban, Natal. Presented by Mr. J. L. Elmore, agent and importer of American goods, Third avenue. Received September 30, 1904.

"These small seeds and pods grow here on the sand next to the seashore, and greatly retard the sand from blowing inland. They grow on runners as much as 30 feet in length, every few feet throwing up stems with large green leaves a foot above the sand, thus preventing the sand from shifting." (*Elmore.*)

11724. PERSEA GRATISSIMA. **Avocado.**

From Durban, Natal. Presented by Mr. J. L. Elmore. Received September 30, 1904, in same package with No. 11723.

"These pears have only been introduced into this country for a few years, and are proving a source of great revenue. The trees are strong and healthy, and bear after about five years' growth—grow as well from seeds as grafted ones. When in season prices range here for the fruit from 50 cents to $2 per dozen. The fruit never ripens on the tree, but soon ripens after it is full grown and picked and laid aside for a few days. This fruit can be transported any distance, as it is perfectly hard when pulled and does not soften for some days. After being laid aside for a few days they become soft and then are edible. The flesh is about one-half inch in thickness, and when ripe of a light yellow shading to a pea green next to the skin, and if eaten with a little sugar and milk is like rich cream. Some prefer salt and pepper and a little vinegar; others nothing at all. I know of people here who eat no meat when these pears are in season. The trees grow in a sandy soil to a good size, and I think they would grow in the Southern States and California." (*Elmore.*)

11725. GARCINIA MANGOSTANA. **Mangosteen.**

From Saigon, Cochin China. Presented by Dr. M. E. Haffner, director of the Botanic Gardens. Received October 3, 1904.

11726. PSIDIUM GUAJAVA. **Guava.**

From Trinidad, British West Indies. Presented by Mr. J. H. Hart, superintendent of the Royal Botanic Gardens. Received October 3, 1904.

A large red guava. Fruit of this variety is reputed to weigh at the rate of three to a pound. (*Hart.*)

11727. PANICUM DECOMPOSITUM. **Australian millet.**

From Sydney, New South Wales. Presented by Mr. J. H. Maiden, director of the Botanic Gardens. Received October 4, 1904.

"From the dry interior of southwestern Queensland. The seed was collected by the blacks, who use it largely for food, while the grass itself is one of the best fodder grasses of Australia." (*Maiden.*) (See Maiden's *Useful Native Plants of Australia*, p. 97.)

11728 to 11730. LILIUM LONGIFLORUM EXIMEUM. **Easter lily.**

From New York, N. Y. Received thru Henry & Lee, August 3, 1904.

11728. Bermuda-grown bulbs.

11729. Azores-grown bulbs.

11730. Japan-grown bulbs.

11731. TRITICUM sp. **Wheat.**

From Germany. Presented by Mr. A. Kirsche, Pfiffelbach, near Apolda, thru Mr. J. E. W. Tracy. Received September 30, 1904.

Original *Winter Square Head.*

11732. GARCINIA MANGOSTANA. **Mangosteen.**

From Singapore, Straits Settlements. Presented by Mr. R. Derry, assistant superintendent of the Botanic Gardens. Received November 18, 1904.

11733. ASPARAGUS VIRGATUS. **Asparagus.**

From Durban, Natal, South Africa. Presented by Mr. J. Medley Wood, curator of the Botanic Gardens. Received November 18, 1904.

"A native Natal asparagus, which is said to produce edible shoots of good quality. The plant does not require so much care as the cultivated asparagus, and may therefore prove of value for breeding purposes." (*Wood.*)

11734. Carissa arduina. **Amatungulu.**

From Natal, South Africa. Presented by Mr. J. Medley Wood, curator of the Botanic Gardens, Durban. Received August 8, 1904.

"A food plant of considerable importance in Natal, where it is found in large quantities on the market, and from which is made a very valuable jelly. The plant, grown in hedge form in and about the city of Durban, is a handsome thing; its large white flowers and crimson fruits stand out in beautiful contrast with the background of dark-green foliage." (*Fairchild.*)

11735. Secale cereale. **Rye.**

From Steglitz, near Berlin, Germany. Received thru Metz & Co., October 6, 1904.

Original *Professor Heinrich.*

11736. Eucalyptus corynocalyx. **Sugar gum tree.**

From Pomona, Cal. Received thru Mr. G. W. Kuesthardt, November 11, 1904.

11737. Poa pratensis. **Kentucky bluegrass.**

From New York, N. Y. Received thru J. M. Thorburn & Co., October 10, 1904.

11738. Vicia sativa. **Common vetch.**

From New York, N. Y. Received thru J. M. Thorburn & Co., October 10, 1904.

11739. Thysanolaena agrostis.

From Sibpur, near Calcutta, India. Presented by the Royal Botanic Garden. Received August 3, 1904.

See S. P. I. No. 8445 for a description of this extremely ornamental flowering cane.

11740. Pentzia virgata.

From Oatlands, South Africa. Received thru Messrs. Lathrop and Fairchild (No. 1138, March, 1903), August 1, 1904. (See No. 10635.)

11741 and 11742. Capsicum annuum. **Paprika pepper.**

From Bridgeport, Ala. Grown by the Botanic Drug Company. Received August 29, 1904.

11741. *Szeged Rose*, grown from S. P. I. No. 10755.

11742. Large, red, long *Hungarian*, grown from S. P. I. No. 10756.

11743 to 11757.

From Melbourne, Australia. Presented by Mr. William Robert Guilfoyle, director of the Botanic Gardens. Received July, 1904.

Sample packets of seed as follows:

11743. Acacia longifolia.
11744. Acacia prominens.
11745. Carpodetus serratus.
11746. Eutelea arborescens.
11747. Eucalyptus botryoides.
11748. Eucalyptus longifolia.
11749. Grevillea robusta.
11750. Hymenosporum flavum.
11751. Panax elegans.
11752. Pittosporum buchanani.
11753. Pittosporum undulatum.
11754. Sterculia acerifolia.
11755. Sterculia diversifolia.
11756. Syncarpia laurifolia.
11757. Tristania laurina.

11758. ULEX EUROPAEUS. **Gorse, whin, or furze.**

From Dublin, Ireland. Presented by Hogg & Robertson, seedsmen. Received in June, 1904.

"This plant is used extensively in northern France, England, and Ireland as a fodder plant. It is not cultivated there, however. Shredders are used for preparing it for stock, and, according to Mr. J. B. Blandy, of Funchal, Madeira, who uses it extensively, it is a most valuable plant for barren soils where other things will not grow." (*Fairchild.*)

11759. VICIA FABA. **Horse bean.**

From Montreal, Canada. Received thru Prof. W. T. Macoum, horticulturist, Central Experiment Farm, Ottawa, Canada, from William Ewing & Co., October 12, 1904.

11760. SECALE CEREALE. **Rye.**

From Waterloo, Kans. Received thru Mr. J. Elza Dodge, October 14, 1904.

Grown from S. P. I. No. 1342.

11761 and 11762. ALLIUM CEPA. **Onion.**

From Teneriffe, Canary Islands. Presented by United States Consul Solomon Berliner. Received October 6, 1904.

11761. *White.* **11762.** *Red.*

11763. VICIA VILLOSA. **Hairy vetch.**

From Augusta, Ga. Received thru the N. L. Willet Drug Company, October 15, 1904.

11764. VICIA SATIVA. **Common vetch.**

From New York, N. Y. Received thru J. M. Thorburn & Co., October 19, 1904.

11765. PERSEA CAROLINENSIS. **Red bay, or swamp bay.**

From New Orleans, La. Presented by Mr. Edward Baker, superintendent of Audubon Park. Received October 17, 1904.

"In regions where the avocado (*Persea gratissima*) can be grown, but which are subject at long intervals to heavy, killing frosts, this relative of the latter may prove valuable as a stock on which to graft it. It may also be of use for breeding purposes." (*Fairchild.*)

11766 to 11768.

From Honolulu, Hawaii. Presented by Mr. Gerrit P. Wilder. Received October 14, 1904.

Specimen fruits as follows:

11766. MANGIFERA INDICA. **Mango.**

"Very fine specimen, grown on the premises of Mr. W. C. Parke, of Honolulu. Considered one of our best mangos here." (*Wilder.*)

11767. (Unidentified.) **11768.** (Unidentified.)

11769. CEDRELA ODORATA.

From Buenos Aires, Argentine Republic. Presented by Mr. Carlos Thays, director of the Jardin Botanico. Received October 22, 1904.

"This plant belongs to a group of trees which Dr. F. Franceschi, of Santa Barbara, Cal., has been studying for some time. He remarks in a letter of September 20, 1903, as follows: 'The Cedrela I consider among the most interesting of the trees which I have tried here, and remarkably so *C. fissilis*, which makes a wonderful growth and appears to be much hardier than its native habitat would warrant.' The use of the timber of this species of Cedrela for cigar boxes makes the plants of unusual interest to southern California, where they will grow unusually well." (*Fairchild.*)

11770. GAILLARDIA sp. **Gaillardia.**

From Big Stone City, S. Dak. Collected by Mr. A. J. Pieters, August, 1904.

"Sample of seed of a Gaillardia with rose-purple rays. Low-growing perennial (?). Flowers borne on peduncle arising from the base of the plant, and usually from a foot to 18 inches high. May be a good thing for crossing with other Gaillardias, but not a sufficiently profuse bloomer by itself." (*Pieters.*)

11771. CHRYSOPSIS HISPIDA. **Golden aster.**

From Dawson, N. Dak. Collected by Mr. A. J. Pieters, August, 1904.

"Found blooming at Dawson, N. Dak., and thruout that country during late August, 1904. Calyx scales glutinous, flowers yellow." (*Pieters.*)

11772. LIATRIS sp. **Button snakeroot.**

From near Fargo, N. Dak. Collected by Mr. A. J. Pieters, August, 1904.

"Seed of a fine perennial for the herbaceous border. Grows 2 to 3 feet high and bears a fine spike with purple flowers." (*Pieters.*)

11773. HELIANTHUS sp. **Sunflower.**

From Dawson, N. Dak. Collected by Mr. A. J. Pieters, August, 1904.

"Practically the same type as that known in the trade as *Stella.* Varies in size from 12 inches to 4 feet or more, depending on soil and moisture." (*Pieters.*)

11774. CUCUMIS sp. **Melon.**

From province of Esmeraldas, Ecuador. Presented by Mr. George D. Hedian. Received September 20, 1904.

"Fruit grows to a size of 48 to 50 cm. in length; yellow when ripe, and pulp resembles that of muskmelon. Has fragrant odor when ripening." (*Hedian.*)

11775. GOSSYPIUM sp. **Cotton.**

From province of Esmeraldas, Ecuador. Presented by Mr. George D. Hedian. Received September 20, 1904.

11776. GOSSYPIUM sp. **Cotton.**

From province of Esmeraldas, Ecuador. Presented by Mr. George D. Hedian. Received September 20, 1904.

This cotton seed in bolls grows 8 feet high and buds in six months.

11777. AMYGDALUS PERSICA. **Nectarine.**

From Kashgar, Kashmir, British India. Presented by Rev. P. J. P. Hendriks. Received October 24, 1904.

"Collected in the latter part of July by Mr. Hendriks at Kashgar and forwarded by parcel post. Mr. Hendriks remarks in his letter of July 23 that 'they want a hot but only a short summer, and as walnuts are ripening in Washington I am confident that they will come all right. You may call them *Crosby* nectarines. I am quite sure they will make a fine acquisition to any orchard.'

"In compliance with the wish of the donor, if these nectarines prove in any way remarkable they should be named in honor of Mr. O. T. Crosby, to whom we are indebted for putting us in communication with Mr. Hendriks." (*Fairchild.*)

11778. PISTACIA VERA. **Pistache.**

From Kashgar, Kashmir, British India. Presented by Rev. P. J. P. Hendriks. Received October 24, 1904.

"These seeds were collected by Mr. Hendriks from the bazaar in Kashgar. He is afraid they will have lost their germinative power, but as they come from the hot valleys of Badakhshan, west of the Pamirs, they may prove a different strain from those introduced from the Levant and to be of unusual value. These were received by parcels post thru Latham & Co., of Bombay, India. Larger shipments must be sent by caravan from Kashgar to Ladak, thence by caravan to Kashmir, thence to Rawlpindi and by rail to Bombay. The costs of transit would be about 2 rupees per kilogram and the time required about two months." (*Fairchild.*)

11779. MANGIFERA INDICA. **Mango.**

From Beira, East Africa. Presented by Hon. Arthur W. H. Glenny, United States consular agent, Beira, East Africa.

Lathrop. See description of No. 9669.

11780. HORDEUM VULGARE. **Barley.**

From McPherson, Kans. Received thru Mr. L. A. Fitz, October 25, 1904.

Tennessee Winter.

11781. SESBANIA MACROCARPA.

From Tucson, Ariz. Received thru Prof. R. H. Forbes, director of the Agricultural Experiment Station, October 25, 1904.

"I am convinced from its very shallow root system that it will probably only prove useful in a situation where it can be constantly and abundantly irrigated, altho it is possible that its rooting habits may be modified by new cultural conditions." (*Forbes.*)

11782. TRIFOLIUM ALEXANDRINUM. **Berseem.**

From Cairo, Egypt. Received thru Mr. George P. Foaden, secretary of the Khedivial Agricultural Society, October 26, 1904.

Fachl.

11783. NUPHAR POLYSEPALUM. **Red-anthered yellow water lily.**

From Bozeman, Mont. Presented by Dr. J. W. Blankinship. Received October 27, 1904.

"An unusual species of pond lily, with red anthers somewhat resembling large petals. As this has never, so far as we are aware, been brought under cultivation, it is thought by Mr. Peter Bisset, of "Twin Oaks," Washington, D. C., to be of possible value for breeding purposes. Coming from the northern latitude of Montana, it will prove perfectly hardy in any part of the United States." (*Fairchild.*)

11784. GARCINIA XANTHOCHYMUS.

From Peradeniya, Ceylon. Presented by Dr. John C. Willis, director of the Royal Botanic Gardens. Received October 29, 1904.

11785 to 11790. GARCINIA spp.

From Peradeniya, Ceylon. Received thru Dr. John C. Willis, director of the Royal Botanic Gardens, October 31, 1904.

11785. G. CAMBOGIA=G. COWA.

11786. G. MANGOSTANA.

11787. G. CAMBOGIA=G. COWA.

11788. G. XANTHOCHYMUS.

11789. G. SPICATA.

11790. G. MORELLA.

11791. VICIA SATIVA. **Common vetch.**

From Corvallis, Oreg. Received thru Mr. John Whitaker, October 31, 1904.

11792. CAESALPINIA BREVIFOLIA. **Algarobillo.**

From Santiago, Chile. Presented by Señor Salvadore Izquierdo. Received September 19, 1904.

The tanning material, which exists in the form of a resinous substance permeating the seed pods of this plant, has recently attracted the serious attention of European tanners, and the imports of it into Germany have of recent years very considerably increased. It is said to be very quick in its action and to be used in the tanning of delicate leathers. American tanners are not familiar with this tanning substance as yet, but some of the principal importers in New York are interested in its introduction. The shrub which bears the pods should be of particular interest to the extremely arid regions of the Southwestern States from the fact that it comes from the high altitudes of the Andes of northern Chile, where the season's rainfall is extremely light and where long periods of hot, dry weather occur. The plant has a long taproot, which will make it difficult to transplant, and it is recommended by Señor Izquierdo that the seeds be planted out where the plants are expected to remain. According to Señor Izquierdo's estimate, 2,000 plants could be easily grown on an acre of soil. Trees 6 to 8 years old are said to yield from 6 to 8 pounds of pods, which sell at a price ranging from 4 to 6 cents a pound. It is said that the plant is injured by heavy spring frosts, but is otherwise a robust, vigorous growing species. (See S. P. I., 10631.)

11793. ANDROPOGON SORGHUM. **Sorghum.**

From Durban, Natal, South Africa. Presented by Mr. R. W. Beningfield. Received August 24, 1904.

Mr. Beningfield says that this sorghum was self-sown in his garden in Durban.

11794. LILIUM LONGIFLORUM MULTIFLORUM. **Japanese lily.**

From New York, N. Y. Received thru Henry & Lee, November 9, 1904.

11795. SAPIUM SEBIFERUM. **Tallow tree.**

From China. Presented by Dr. C. L. Marlatt to Dr. B. T. Galloway. Planted in October, 1903.

Chinese name "Sa-men."

11796. CUCUMIS MELO. **Muskmelon.**

From California. Received in 1902. Exact source is not known.

Genuine *Bidwell Casaba* muskmelon seed, turned over to this Office by Mr. W. W. Tracy, sr.

11797. MACADAMIA TERNIFOLIA. **Australian nut.**

From Sydney, New South Wales. Presented by Mr. J. H. Maiden, director of the Botanic Gardens. Received November 5, 1904.

11798. PAPAVER SOMNIFERUM × BRACTEATUM. **Hybrid poppy.**

From Santa Rosa, Cal. Presented by Mr. Luther Burbank. Received November 7, 1904.

11799. THEVETIA CUNEIFOLIA. **Trumpet flower.**

From Guadalajara, Mexico. Presented by Mr. Federico Chisolm. Received November 7, 1904.

11800. PANICUM MAXIMUM. **Guinea grass.**

From Mayaguez, P. R. Received thru Mr. O. W. Barrett, of the Agricultural Experiment Station, November 8, 1904.

"Tho it produces viable seeds, this famous grass is usually propagated by division of the root clumps." (*Barrett.*)

11801 to 11996. PHOENIX DACTYLIFERA. **Date.**

From Hofhuf, El-Hasa, Turkish Arabia. Received thru Rev. S. M. Zwemer and secured by Mr. J. Calcott Gaskin, of the British Assistant Political Agency, Bahrein Island, Persian Gulf, November 7, 1904.

According to Mr. Gaskin's letter, the following varieties were received: *Khalas, Rezeiz, Shebibi, Khir, Hatmi, Sheishi, Mehmi, Kheneizi, Tenâjil,* and *Mejnaz.* These names, however, did not agree with those found on the labels accompanying the plants, which were placed there by the Arabs and most of which were lost. In order to avoid confusion each sucker was given a separate number in hopes that they might be correctly identified from descriptions of these varieties when they come into bearing.

11997. SEQUOIA WELLINGTONIA. **Bigtree.**

Origin unknown.

11998. VICIA FABA. **Horse bean.**

From Gembloux, Belgium. Received thru Dr. Ach. Grégoire, Institut Chimique et Bactériologique de l'État, March 10, 1905.

"Seed of the Holland variety of horse bean grown extensively in Belgium and Holland as a fodder crop. This bean in the cool summers of northern Europe makes a growth of several feet and produces a succulent fodder which is harvested after the beans have ripened, and run thru a chopping machine which prepares it for the stock. The analyses of Doctor Grégoire have shown that there is a material increase in the amount of nutritious substances in this bean late in the season, making it advisable to cut it only after the beans have fully matured. The small size of the bean of this Dutch variety makes it especially desirable for field experiments where the item of seed transport is an important one.

"These should be tried extensively in Alaska and the Northwestern States as an early summer crop. They are likely also to be of value as a cover crop for orchards in the Northern States. Experiments in Canada have proved this horse bean to be the best cover crop yet tried in that region. It holds snow, prevents drifting, and adds a large amount of humus to the soil. In Belgium these beans are drilled in about 6 or 8 inches apart and produce a thick stand some 3 or 4 feet in height." (*Fairchild.*)

11999 and 12000. NICOTIANA TABACUM. **Tobacco.**

From Constantinople, Turkey. Received thru Mr. Charles M. Dickinson, United States consul-general, March 9, 1905.

Seed from Xanthi district, as follows:

11999. Finest quality.

12000. Medium quality.

12001 to 12018.

From Fort Hays, Kans. Received thru Mr. J. G. Haney, superintendent of the Branch Experiment Station, November 7, 1904.

12001 to 12015. TRITICUM VULGARE. **Wheat.**

12001. *Kharkof.* Grown from S. P. I. No. 7786. C. I. No. 2193.
12002. *Beloglino.* Grown from S. P. I. No. 7787. C. I. No. 1667.
12003. *Crimean.* Grown from S. P. I. No. 5636. C. I. No. 1437.
12004. *Theiss.* Grown from S. P. I. No. 5497. C. I. No. 1561.
12005. *Ulta.* Grown from S. P. I. No. 5638. C. I. No. 1439.
12006. *Ghirka.* Grown from S. P. I. No. 5637. C. I. No. 1438.
12007. *Crimean.* Grown from S. P. I. No. 5635. C. I. No. 1436.
12008. *Kharkof.* Grown from S. P. I. No. 7467. C. I. No. 1583.
12009. *Kharkof.* Grown from S. P. I. No. 5641. C. I. No. 1442.

12001 to 12018—Continued.

12010. *Crimean.*

Grown from seed originally imported in quantity of over 14,000 bushels from the Crimea in 1901 by the millers of Kansas and Oklahoma. C. I. No. 1559.

12011. *Banat.* Grown from S. P. I. No. 5496. C. I. No. 1560.

12012. *Bacska.* Grown from S. P. I. No. 5498. C. I. No. 1562.

12013. *Turkey.* Grown from C. I. No. 1558.

The best grade of this variety was grown near Halstead, Kans., from seed originally from the Crimea. A sample was planted in the experiment plats at Halstead in the autumn of 1901 for future experiment.

12014. *Weissenberg.* Grown from S. P. I. No. 5499. C. I. No. 1563.

12015. *Pesterboden.* Grown from S. P. I. No. 5500. C. I. No. 1563.

12016 to 12018. PANICUM MILIACEUM. **Broom-corn millet.**

12016. *Red Voronezh.* Grown from S. P. I. No. 9424. Original seed from Russia.

12017. *Black Voronezh.* Grown from S. P. I. No. 9425. Original seed from Russia.

12018. *Red Orenburg.* Grown from S. P. I. No. 9423. Original seed from Russia.

12019. GARCINIA XANTHOCHYMUS.

From Honolulu, Hawaii. Presented by Mr. G. P. Wilder. Received October 31, 1904.

"Fruits from a tree growing in the Government nursery of Honolulu. Sent for identification. This species is promising as a stock upon which to graft the mangosteen. Its fruits have an agreeable acid flavor." (*Fairchild.*)

12020. PORTULACARIA AFRA. **Spek-boom.**

From Durban, Natal. Received thru Messrs. Lathrop and Fairchild (No. 1097, February 8, 1903), November 9, 1904.

"A native South African shrub or small tree with succulent shoots which, according to von Müller, has been tested for many years in Australia, and which Mr. John M. Wood, of the Durban Botanic Garden, says has been sent to Algeria for experimental purposes. The shoots are said to be keenly relished by live stock, and the plant is reported to grow on dry, waste places without requiring attention. The cuttings take root easily, and von Müller says that the plant may even be propagated from the leaves. The range of this species is not known by the writer, but it will probably thrive only in a frostless region. The plant grows on hot, rocky slopes, preferably of doleritic nature. Plant on stony ridges or in sandy, desert soil. This species deserves to be given a wide distribution in regions where it will grow wild, and should be called to the attention of those interested in the cattle-range question of Arizona and Hawaii. These cuttings were donated by Mr. Wood." (*Fairchild.*)

12021. GARCINIA COCHINCHINENSIS.

From Durban, Natal. Received thru Messrs. Lathrop and Fairchild (No. 1102, February 8, 1903), November 9, 1904.

"This tree is a more vigorous one and easier to adapt to cultivation than *G. mangostana*, the true mangosteen. It is also a heavier bearer, and it is valuable in connection with experiments on the cultivation of the mangosteen in Porto Rico and Hawaii. The fruit is a golden-yellow color, one-seeded, with characteristic acid-flavored pulp. Most people do not care for the taste of this fruit, but the writer found the fruits most refreshing, and Mr. Wood, of the Botanic Gardens in Durban, who kindly donated the seeds, says that a former governor of Natal was very fond of them. Trees of this species should be raised in gardens in Florida, Porto Rico, and Hawaii accessible for breeding and grafting experiments. It may prove a good stock for the mangosteen." (*Fairchild.*)

12022. GARCINIA MANGOSTANA. **Mangosteen.**

From Singapore, Straits Settlements. Presented by Mr. R. Derry, assistant superintendent of the Botanic Gardens. Received November 9, 1904.

12023. HORDEUM DISTICHUM. **Two-row barley.**

From Fresno, Cal. Received thru Mr. George C. Roeding, December 22, 1904.

White Smyrna. Grown from S. P. I. No. 7969.

12024 and 12025. SECHIUM EDULE. **Chayote.**

From Saltillo, Mexico. Presented by Mr. J. R. Silliman at the request of Dr. Edward Palmer. Received November 7, 1904.

"An unusually large and fine variety of the chayote, representing two doubtful subvarieties, the one a darker green in color than the other and considered a sweeter sort. This is considered one of the best, and is indeed one of the most commonly grown vegetables in Mexico and Central America. The particularly large size of these varieties makes them promising for introduction into the warmer regions of this country. Bulletin No. 28 of the Bureau of Plant Industry gives a full description of the methods of planting, etc." (*Fairchild.*)

12026 and 12027. ZEA MAYS. **Corn.**

From Saltillo, Mexico. Presented by Mr. J. R. Silliman. Received November 7, 1904.

12026. Genuine white *Mexican June.*
12027. Genuine red *Mexican June.*

"I am sending you four ears of genuine *Mexican June* corn grown by myself. This corn was planted in June and harvested about the 15th of October. The natives mix their seed very much and are not at all careful with it, so a great deal of the so-called *Mexican June* corn is not strictly such. Of the white variety there are two classes—one with white cob, the other with red cob. The grains are long and thin, the cob very small. It is a great drought resister and very sweet, the Mexican children chewing the stalks as they do sugar cane. Cattle are very fond of the green stalk and it produces a fine flow of rich milk in cows. The stalk reaches a height of 8 to 12 feet and is very slender; therefore we plant it quite thick. The dark variety, or *Maíz pinto*, is considered more hardy and better for resisting dry weather. It is shorter and more stocky in its growth. It is not so sweet. It will give a crop when all else fails. While not considered so fine for general use, it is equal to any for all stock." (*Silliman.*)

12028 to 12103. PAEONIA spp. **Peony.**

From Langport, Somerset, England. Received thru Messrs. Kelway & Son, November 12, 1904.

Peonies imported for testing on the grounds of the Department of Agriculture at Arlington, Va., 76 varieties, as follows:

12028. *Maria Kelway.*
12029. *Agnes Mary Kelway.*
12030. *Lady Curzon.*
12031. *Princess Beatrice.*
12032. *Mrs. Chamberlain.*
12033. *Mountebank.*
12034. *Festiva Maxima.*
12035. *Princess Irene.*
12036. *Duke of Clarence.*
12037. *Lady Beresford.*
12038. *Limosel.*
12039. *Paderewski.*
12040. *Mad Calot.*
12041. *Torquemada.*
12042. *Glory of Somerset.*
12043. *Prince of Wales.*
12044. *Leonard Kelway.*
12045. *Dorothy Welsh.*
12046. *Alonzo.*
12047. *Grizzel Muir.*
12048. *Solfaterre.*
12049. *Lottie Collins.*

12028 to 12103—Continued.

12050. *Kelway's Queen.*
12051. *Helena.*
12052. *Joan Seaton.*
12053. *Princess Christian.*
12054. *Princess of Wales.*
12055. *Lady Gwendolen Cecil.*
12056. *Mrs. Asquith.*
12057. *Stanley.*
12058. *Prince George.*
12059. *Cognita.*
12060. *Duchess of Teck.*
12061. *Autumnus.*
12062. *Humei White.*
12063. *Summer Day.*
12064. *Moonbeam.*
12065. *Reine des Français.*
12066. *Whitleyi Plena.*
12067. *Prince Prosper.*
12068. *Lady Carrington.*
12069. *Sir T. J. Lipton.*
12070. *Princess May.*
12071. *Queen Victoria.*
12072. *Miss Salway.*
12073. *Bunch of Perfume.*
12074. *Millais.*
12075. *Tinted Venus.*
12076. *Miss Brice.*
12077. *Nominata.*
12078. *Calliphon.*
12079. *Duke of Devonshire.*
12080. *Baroness Schroeder.*
12081. *The Bride.*
12082. *Ella Christine Kelway.*
12083. *Cyclops.*
12084. *Sainfoin.*
12085. *Venus.*
12086. *Duchess of Sutherland.*
12087. *Mr. Manning.*
12088. *Queen of the May.*
12089. *Lady Cecilia Rose.*
12090. *Viscount Cross.*
12091. *Lyde.*
12092. *Water Lily.*
12093. *Princess Dhuleep Singh.*
12094. *Cendrillon.*
12095. *Alton Locke.*
12096. *Argus.*
12097. *Hesperus.*
12098. *Amiable.*
12099. *Lady Bramwell.*
12100. *Cavalleria Rusticana.*
12101. *Emily.*
12102. *Clothos.*
12103. *Opiter.*

12104. FREYCINETIA ARBOREA.

From Honolulu, Hawaii. Received thru Mr. J. E. Higgins, horticulturist, Agricultural Experiment Station, November 14, 1904.

12105 to 12107. NICOTIANA TABACUM. **Tobacco.**

From Brazil. Presented by Mr. M. Caluron, secretary of Agriculture, Railways, Industry, and Public Works of the State of Bahia. Received October 31, 1904.

12105. From Santa Anna.
12106. From Maragogipe.
12107. From S. Gonçalo dos Campos.

12108. CUCUMIS MELO. **Muskmelon.**

From Bairam Ali, Old Merv, Turkestan. Presented by Prof. R. W. Pumpelly. Received November 12, 1904.

12109. CUCUMIS MELO. **Muskmelon.**

From Samarkand, Turkestan. Presented by Prof. R. W. Pumpelly. Received November 12, 1904.

12110. CALOPHYLLUM INOPHYLLUM.

From Honolulu, Hawaii. Received thru Mr. Gerrit P. Wilder, November 15, 1904.

"Imported for use as a possible stock on which to graft the mangosteen, *Garcinia mangostana*." (*Fairchild.*)

12111 and 12112.

From Nice, Alpes-Maritimes, France. Presented by Dr. A. Robertson-Proschowsky. Received November 14, 1904.

12111. FICUS GLOMERATA. **Cluster fig.**

12112. OPUNTIA FICUS INDICA. **Prickly pear.**

12113. SOLANUM COMMERSONI. **Aquatic potato.**

From Santa Rosa, Cal. Presented by Mr. Luther Burbank. Received November 18, 1904.

"Tubers produced from plants grown in Mr. Burbank's experimental grounds from imported tubers, S. P. I. No. 10324. First generation removed from importation." (*Fairchild.*)

12114. JUGLANS REGIA. **Persian walnut.**

From Khojend, Russian Central Asia. Received thru Mr. E. Valneff, November 15, 1904.

12115. SECHIUM EDULE. **Chayote.**

From Mexico. Received thru Dr. Edward Palmer, November 21, 1904.

12116 to 12119. HORDEUM spp. **Barley.**

From Milwaukee, Wis. Presented by Mr. G. G. Pabst, president of the Pabst Brewing Company. Received November 9, 1904.

Four samples of barley grown from seed furnished by this Department, originally purchased in Svalöf, Sweden, from the General Swedish Seed-Breeding Institute, as follows:

12116. HORDEUM DISTICHUM NUTANS.

Prinsess. Grown from S. P. I. No. 10583 on the Summer farm, Wauwatosa, Wis. Yielded 13 bushels from 1 peck of seed.

12117. HORDEUM DISTICHUM NUTANS.

Chevalier II. Grown from S. P. I. No. 10584 on the Wasson farm, Granville, Wis. Yielded 5½ bushels from 1 peck, approximately.

12118. HORDEUM DISTICHUM NUTANS.

Hannchen. Grown from S. P. I. No. 10585 on the Wasson farm, Granville, Wis. Yielded 7 bushels from 1 peck of seed.

12119. HORDEUM DISTICHUM ERECTUM.

Primus. Grown from S. P. I. No. 10586 on the farm of Mr. John Schubert, Granville, Wis. Yielded 4 bushels from 1 peck of seed.

12120 to 12129. HORDEUM spp. **Barley.**

From Milwaukee, Wis. Presented by Mr. August Uihlein, secretary of the Schlitz Brewing Company. Received November 21, 1904.

Barley samples, as follows:

12120. HORDEUM TETRASTICHUM.

Albacete. Grown from S. P. I. No. 7427, originally from Spain.

12120 to 12129—Continued.

12121. HORDEUM DISTICHUM.

Grown from S. P. I. No. 7992, originally from Munich, Bavaria.

12122. HORDEUM HEXASTICHUM.

Grown from S. P. I. No. 8559, originally from Christiania, Norway.

12123. HORDEUM VULGARE.

Maraout. Grown from S. P. I. No. 9877, originally from Cairo, Egypt.

12124. HORDEUM sp.

Grown from California seed that was originally imported from Moravia.

12125. HORDEUM DISTICHUM NUTANS.

Hanna. Grown from S. P. I. No. 10402, originally from Austria.

12126. HORDEUM DISTICHUM NUTANS.

Prinsess. Grown from S. P. I. No. 10583, originally from Sweden.

12127. HORDEUM DISTICHUM NUTANS.

Chevalier II. Grown from S. P. I. No. 10584, originally from Sweden.

12128. HORDEUM DISTICHUM NUTANS.

Hannchen. Grown from S. P. I. No. 10585, originally from Sweden.

12129. HORDEUM DISTICHUM ERECTUM.

Primus. Grown from S. P. I. No. 10586, originally from Sweden.

12130. ORYZA SATIVA. **Rice.**

From Calcutta, India. Received thru I. Henry Burkill, esq., M. C., officiating reporter on economic products to the government of India, Indian Museum, October 21, 1904.

Rekikesh paddy seed, said to be the most valuable rice in India; grown on the Ganges where it emerges from the hills. A lowland variety of rice, said to be worth twenty times the price of ordinary rice.

12131. XANTHOXYLUM PIPERITUM. **Japanese pepper.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company, November 14, 1904.

12132 to 12134.

From Brighton, Utah. Received thru Mr. Ephraim Clawson, November 10, 1904.

12132. TRIFOLIUM ALEXANDRINUM. **Berseem.**

12133. AVENA SATIVA. **Oat.**

Grown from S. P. I. No. 10269, originally from Algeria.

12134. TRITICUM VULGARE. **Wheat.**

Chul-bidai. Grown from S. P. I. No. 9131, originally from Russia.

12135. VICIA ATROPURPUREA.

From Santa Clara, Cal. Received thru Mr. C. C. Morse in 1904.

12136 and 12137.

From London, England. Received thru Messrs. James Veitch & Sons (Limited), Chelsea, S. W., November 25, 1904.

12136. EUCOMMIA ULMOIDES. **Tu-chung.**

"*Tu-chung* is the name given by the Chinese to the tree which has been described by Professor Oliver in Hooker's Icones Plantarum as *Eucommia*

12136 and 12137—Continued.

ulmoides. The bark is the only part used, and is much esteemed by the Chinese as a drug, tonic and various other properties being assigned to it. It is described in nearly all Chinese works on materia medica and botany, the earliest mention of it being given in the Herbal of which the Emperor Shên-Nung is the reputed author, and which was committed to writing probably as early as the first century of our era.

"The tree is cultivated in small plantations in the mountainous regions of Szechwan, Hupeh, and Shensi; and from these districts it is brought to Hankow, the great mart for drugs that are produced in the western provinces. From this port about 100 tons are annually exported by steamer to the other treaty ports.

"*Eucommia ulmoides* has been grown out of doors at Kew without any protection for the last six years. It is a vigorous, free-rooting plant, and bears transplanting well. It will, I believe, thrive in any soil of average quality, but seems to prefer a rich, light loam. In such a soil, at Kew, young trees struck from cuttings five years ago are now 6 feet high and make shoots 2 feet to 2½ feet long in one season.

"It can be propagated easily by means of cuttings, and with these two methods may be adopted. The quickest method is to take pieces of the current season's growth, about 6 inches long, in late July or early August, insert them in pots of very sandy soil (the usual mixture for cuttings), and then place the pots in a house or frame where slight bottom heat can be afforded. The cuttings should be made of shoots in what gardeners term a "half-woody" condition. They will take root in a few weeks and can then, after a "hardening-off" period, be planted in nursery beds. The second method is to make the cuttings of the leafless wood in November and dibble them in sandy soil in a cool frame or out of doors under a *cloche,* or hand light. They will take root the following spring. This method is not so quick as the other, nor have we found it so sure." (*Kew Bulletin No. 1, 1904.*)

12137. DAVIDIA INVOLUCRATA. **Davidia.**

(See description of this beautiful tree under S. P. I. No. 16208.)

12138. MANGIFERA INDICA. **Mango.**

From Miami, Fla. Received thru P. H. Rolfs, November 23, 1904.

Gordon. Grown from S. P. I. No. 3705.

12139. NICOTIANA SANDERAE. **Flowering tobacco.**

From Philadelphia, Pa. Received thru Henry A. Dreer, Incorporated, November 25, 1904.

Carmine tuberose-flowered. Seed of a new hybrid Nicotiana raised in England. Described as forming bushy, much-branched plants 2 feet high, laden with flowers from base to summit. Flowers are a carmine red and fragrant, a single plant producing thousands. Resembles *N. affinis* in form, but has a short, stout tube and does not close up in daytime. (See No. 12358 for history.)

12140 to 12230.

From Yokohama, Japan. Received thru the Yokohama Nursery Company at the Plant Introduction Garden, Chico, Cal., October 31, 1904.

12140. ARALIA CORDATA. **Moyashi udo.**

Two-year-old roots.

12141. CITRUS sp. **Orange.**

Natsudaidai.

12142. EDGEWORTHIA GARDNERI. **Mitsumata paper plant.**

12143 to 12155. LILIUM spp. **Lily.**

12143. LILIUM ALEXANDRAE.

12144. LILIUM AURATUM.

12145. LILIUM BATMANNIAE.

12146. LILIUM BROWNII.

12140 to 12230—Continued.

12143 to 12155—Continued.

12147. Lilium cordifolium.
12148. Lilium concolor.
12149. Lilium hansoni.
12150. Lilium krameri.
12151. Lilium leichtlini.
12152. Lilium longiflorum.
12153. Lilium medeoloides.
12154. Lilium speciosum album.
12155. Lilium tigrinum.

12156. Miscanthus condensatus.

12157 to 12176. Nelumbium speciosum. **Lotus.**

12157. *Tenjiku ren.*
12158. *Tenjiku madara.*
12159. *Hichiyo ren.*
12160. *Taihaku ren.*
12161. *Toka ren.*
12162. *Higo shibori.*
12163. *Shokko ren.*
12164. *Tama usagi.*
12165. *Shiro manman.*
12166. *Nikko ren.*
12167. *Giozan ren.*
12168. *Kayo ren.*
12169. *Haku botan.*
12170. *Sakura ren.*
12171. *Usuyo ren.*
12172. *Seihaku ren.*
12173. *Shosho ren.*
12174. *Beni botan.*
12175. *Kinshi ren.*
12176. *Asahi ren.*

12177. Phyllostachys henonis. **Bamboo.**

12178. Phyllostachys mitis. **Bamboo.**

12179. Phyllostachys nigra. **Bamboo.**

12180. Phyllostachys quilioi. **Bamboo.**

12181 to 12230. Prunus pseudo-cerasus. **Flowering cherry.**

12181. *Koshioyama.*
12182. *Yaye hizakura.*
12183. *Oshokun.*
12184. *Haru arashi.*
12185. *Haria sau.*
12186. *Kurama yama.*
12187. *Higau shidare.*
12188. *Oshibayama.*
12189. *Beni gamo.*
12190. *Kongasau.*
12191. *Shira taye.*
12192. *Batan zakura.*
12193. *Strogetsu.*
12194. *Aki irosakura.*
12195. *Ben den.*
12196. *Asagi sakura.*
12197. *Kumagai sakura.*
12198. *Nara (?) sakura.*
12199. *Kirigaya.*
12200. *Kafugen.*
12201. *Benihigan.*
12202. *Washi-no-O.*
12203. *Kiuriuji.*
12204. *Onaden.*
12205. *Ichiyo.*
12206. *Gigo.*
12207. *Meigetsu.*
12208. *Jouioi.*
12209. *Hizakura* (single).
12210. *Mikuruma gaishi.*
12211. *Hosokawa nioi.*
12212. *Horinji.*
12213. *Hata sakura.*
12214. *Ochochin.*
12215. *Yokihi.*
12216. *Shiogama sakura.*
12217. *Toyama sakura.*
12218. *Kokishinuden.*

12140 to 12230—Continued.

12181 to 12230—Continued.

12219. *Nikoromoki.*
12220. *Hakukezan.*
12221. *Gozanoma nioi.*
12222. *Kikushidase.*
12223. *Taki nioi.*
12224. *Heto maru.*
12225. *Senreko.*
12226. *Totankisakura.*
12227. *Amano gawa.*
12228. *Fugenzo.*
12229. *Ouchizakma.*
12230. *Kiriu.*

12231. MEDICAGO SATIVA. **Alfalfa.**

From Vernon, Tex. Received thru Mr. J. A. White, November 28, 1904.

Turkestan. Grown from S. P. I. No. 9450.

12232. PISTACIA TEREBINTHUS. **Terebinth.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., November 23, 1904.

12233. HYACINTHUS ORIENTALIS ALBULUS. **Hyacinth.**

From New York, N. Y. Received thru J. M. Thorburn & Co., November 26, 1904.

12234. PHLEUM PRATENSE. **Timothy.**

From Tunis, Tunis. Presented by Prof. R. Gagey, of the Agricultural College. Received November 30, 1904.

12235. LILIUM PHILIPPINENSE. **Benguet lily.**

From Manila, P. I. Presented by Mr. Elmer D. Merrill. Received November 15, 1904. Collected by Mr. R. S. Williams, collector for the New York Botanical Gardens in the province of Benguet, P. I.

12236 and 12237.

From Clearbrook, Whatcom County, Wash. Presented by Mr. George Gibbs. Received December 2, 1904.

12236. ACER MACROPHYLLUM. **Oregon maple.**

"Handsome, roundheaded tree, remarkable for its large foliage. Not hardy in the North. In western Washington these maples grow from 2 to 5 feet the first year from seed. They are the finest of street shade trees, and stand any amount of wind. They grow 60 feet high at Clearbrook and reach 3 to 6 feet in diameter." (*Gibbs.*)

12237. THUJA GIGANTEA. **Giant arbor vitae.**

12238. LANSIUM DOMESTICUM. **Doekoe.**

From Buitenzorg, Java. Presented by Doctor Treub. Received December 5, 1904.

"One of the most refreshing fruits of the Dutch East Indies, which deserves to be well known in the Western Tropics, but which hitherto seems to have been quite overlooked." (*Fairchild.*)

"A low-growing tree of the East Indies which is cultivated to some extent for its fruit, which is known in Java and Malakka as 'Lanseh' fruit and is much esteemed for its delicate aroma. The pulp is of somewhat firm consistence and contains a cooling, refreshing juice." (*Jackson in Trans. Linn. Soc., XIV, 1 (1823), 115.*)

12239. AGAPANTHUS UMBELLATUS.

From Washington, D. C. Received thru the National Botanic Garden in 1902.

12240. MANGIFERA INDICA. **Mango.**

From Manatee, Fla. Received thru Mr. A. J. Pettigrew, December 7, 1904.

Peters No. 1. Grown from S. P. I. No. 3706.

12241. MANGIFERA INDICA. **Mango.**

From Mangonia, Fla. Presented by Rev. E. E. Gale. Received December 7, 1904.

Père Louis. Grown from S. P. I. No. 3707.

12242. BERBERIS FREMONTII.

From Tucson, Ariz. Received thru Mr. D. G. Fairchild at the Plant Introduction Garden, Chico, Cal., September 10, 1904.

"Seeds from plants growing on the experiment station grounds. A beautiful desert form for breeding with *B. thunbergii.*" (*Fairchild.*)

12243. PISTACIA VERA. **Pistache.**

From northern Syria. Received thru Mr. W. T. Swingle at the Plant Introduction Garden, Chico, Cal., October 6, 1904.

"These seeds were grown from trees grafted on *P. mutica* and were obtained from a Mr. Nazar, whose people graft the pistache on this species in the dry country near the Euphrates River." (*Swingle.*)

12244 to 12302.

A collection of bulbs secured for experimental work in the Department bulb garden.

12244 to 12265.

From Hillegom, Haarlem, Holland. Received thru Vander Schoot & Son, October, 1903.

12266 to 12276.

From London, England. Received thru William Bull & Sons, November, 1903.

12277 to 12279.

From Clearbrook, Wash. Received thru Mr. George Gibbs, November, 1904.

12280 to 12298.

From Guernsey, England. Received from Hubert & Co., September, 1904. Purchased thru Mr. Nicholas Le Page, Mount Vernon, N. Y.

12299 to 12302.

From Ettrick, Va. Received thru Poat Brothers, October, 1904.

12303. AVENA SATIVA. **Oat.**

From Brookings, S. Dak. Received thru Mr. H. I. Stearns, December 8, 1904.

Sixty-Day. Grown from S. P. I. No. 5938.

12304. SECHIUM EDULE. **Chayote.**

From New Orleans, La. Presented by the J. Steckler Seed Company. Received November 23, 1904.

12305. MANGIFERA INDICA. **Mango.**

From West Palm Beach. Fla. Received thru Mr. John B. Beach, December 9, 1904.

Mulgoba.

12306. Gossypium sp. **Cotton.**

From the Philippine Islands. Presented by Dr. B. D. Halsted, Agricultural Experiment Station, New Brunswick, N. J. Received December 6, 1904.

Kaki. These seeds were collected by Mr. A. Ellicott Brown, of the Marine Corps, and sent to Doctor Halsted.

12307 to 12357. Salix spp. **Willow.**

From Ottawa, Canada. Presented by Dr. William Saunders, director of the Central Experimental Farm. Received December 14, 1902.

A collection of species and varieties of willow growing in the arboretum of the Central Experimental Farm at Ottawa. The nomenclature given is that recognized by the Experimental Farm.

12307. Salix caesia pendula zabeli.

12308. Salix nigricans prunifolia.

12309. Salix daphnoides pomerania femina.

12310. Salix triandra (S. lappeana).

12311. Salix purpurea scharfenbergensis.

12312. Salix casiandra lancifolia.

12313. Salix fragilis basfordiana.

12314. Salix rubra forbyana.

12315. Salix argentea aurita.

12316. Salix nigricans moabitica.

12317. Salix bataviae.

12318. Salix alba britzensis.

12319. Salix nigricans cotinifolia.

12320. Salix alba vitellina.

12321. Salix daphnoides femina.

12322. Salix petiolaris.

12323. Salix seringeana.

12324. Salix alba vitellina.

12325. Salix erdingeri.

12326. Salix nigricans ansoniana.

12327. Salix purpurea urabensis.

12328. Salix undulata.

12329. Salix viminalis.

12330. Salix daphnoides mascula.

12331. Salix blanda (S. babylonica × fragilis).

12332. Salix bicolor laureana.

12333. Salix decipiens.

12334. Salix alba vitellina aurantiaca.

12335. Salix purpurea lambertiana.

12336. Salix cinerea tricolor.

12337. Salix ambigua.

12338. Salix voronesh.

12339. Salix smithiana acuminata (S. dasyclados).

12340. Salix pellita.

12341. Salix repens argentea.

12342. Salix longifolia.

12343. Salix laurina.

12344. Salix babylonica.

12345. Salix cinerea repens.

12346. Salix fragilis ammaniana.

12347. Salix alba argentea.

12348. Salix nigricans menthaefolia.

12349. Salix rosmarinifolia.

12350. Salix nigricans.

12351. Salix mollissima.

12352. Salix viminalis superba.

12353. Salix hippophaefolia undulata.

12354. Salix spaethii.

12355. Salix cordata vestita.

12356. Salix alba vitellina nova.

12357. Salix nigricans viburnoides.

12358. NICOTIANA SANDERAE. **Flowering tobacco.**

From New York, N. Y. Received thru J. M. Thorburn & Co., December 14, 1904.

Carmine-flowered. "This variety is the result of crossing the dwarf purple-flowered *N. forgetiana*, from Brazil, with *N. affinis*, the well-known, fragrant white-flowered garden annual." (*Sander & Sons.*)

12359. LATHYRUS ODORATUS. **Sweet pea.**

From Covent Garden, W. C., London, England. Received thru Watkins & Simpson, 12 Tavistock street, December 9, 1904.

Gladys Unwin.

12360. AFZELIA QUANZENSIS.

From Cape Town, Cape Colony, Africa. Received thru Dr. Peter MacOwan, government botanist, November 28, 1904.

12361. LATHYRUS SYLVESTRIS. **Flat pea.**

From New York, N. Y. Received thru J. M. Thorburn & Co., November 21, 1904.

12362 and 12363.

From Bangkok, Siam. Presented by His Excellency Phya Akharaj Varadhara, the Siamese minister, to Dr. B. T. Galloway. Received December 2, 1904.

Plants used extensively in Bangkok as a condiment.

12362.	**12363.**
Krawan.	(No name given.)

12364. LILIUM GIGANTEUM. **Lily.**

From New York, N. Y. Received thru Henry & Lee, December 13, 1904.

12365. PANICUM MAXIMUM. **Guinea grass.**

From Mayaguez, P. R. Received thru the Agricultural Experiment Station, December 21, 1904.

12366. SECHIUM EDULE. **Chayote.**

From New Orleans, La. Received thru the J. Steckler Seed Company, December 16, 1904.

12367. DAHLIA sp. **Dahlia.**

From "La Trinidad," Guerrero, Mexico. Received thru Mr. Federico Chisolm, December 13, 1904.

12368. GLADIOLUS GANDAVENSIS. **Gladiolus.**

From Philadelphia, Pa. Received thru Henry A. Dreer, Incorporated, December 16, 1904.

White Lady.

12369. PACHYRHIZUS sp.

From Santa Maria del Rio, Mexico. Received thru Dr. Edward Palmer, December 21, 1904.

"There are two forms of this Pachyrhizus, one called *Agua* (water) and the other *Leche* (milk). These two forms have been long recognized, but not as separate species. At Santa Maria del Rio I saw several fields of this plant cultivated on ridges so that the plants might be irrigated. I was informed that both forms were grown in the same patch and could not be distinguished either by their foliage or flowers, and that it was only by tasting the roots themselves that the difference could be detected. Both varieties are considered equally valuable. They are eaten raw, especially by travelers on long tours thru the drier portions of the country, as their watery character makes them valuable for quenching one's thirst. They are also considered nutritious and are said to make good pickles. It is possible that they may also be cooked as turnips are and could be cultivated in regions where the turnip will not thrive.” (*Palmer.*)

12370. IRIS sp. **Iris.**

From Fairfield, Wash. Collected by Mr. A. J. Pieters, August 21, 1904.

12371 to 12393. **Abyssinian seeds.**

From Abyssinia, Africa. Received thru Hon. Robert P. Skinner, commissioner of the United States to Abyssinia, December 15, 1904.

A collection of seeds made for Mr. Skinner under his direction by Mr. Eugène Carette Bouvet. This collection is supplementary to the collection received June 3, 1904, Nos. 11039 to 11119, from the same source. The names given are transcribed from those written upon the original packages.

12371.	ANDROPOGON SORGHUM.	**Sorghum.**
12372.	ANDROPOGON SORGHUM.	**Sorghum.**
12373.	ANDROPOGON SORGHUM.	**Sorghum.**
12374.	ANDROPOGON SORGHUM.	**Sorghum.**
12375.	HORDEUM sp.	**Barley.**
12376.	HORDEUM sp.	**Barley.**
12377.	TRITICUM sp.	**Wheat.**
12378.	ERAGROSTIS ABYSSINICA.	**Teff.**
12379.	TRITICUM DIOCOCCUM.	**Emmer.**
12380.	COFFEA sp.	**Wild coffee.**
12381.	COFFEA sp.	**Harrar coffee.**
12382.	COFFEA sp.	**Cultivated coffee.**
12383.	ZEA MAYS.	**Corn.**
12384.	ZEA MAYS.	**Corn.**
12385.	ERAGROSTIS ABYSSINICA.	**Teff.**
12386.	ERAGROSTIS ABYSSINICA.	**Teff.**
12387.	SESAMUM INDICUM.	**Sesame.**
12388.	PIMPINELLA ANISUM.	**Anise.**
12389.	GUIZOTIA OLEIFERA.	
12390.	ELEUSINE CORACANA.	
12391.	LINUM sp.	**Flax.**
12392.	PISUM SATIVUM.	**Pea.**
12393.	CICER ARIETINUM.	**Chick-pea.**

12394. BETA VULGARIS. **Sugar beet.**

From New York, N. Y. Received thru Mr. Albert Bohm, Wool Exchange Building, West Broadway and Beach streets, December 21, 1904.

Said by Mr. Bohm to be more subject to outside influences than ordinary seed.

12395. PHYSALIS sp. **Ground cherry.**

From Columbus, Ohio. Received thru the Livingston Seed Company, December 23, 1904.

Ordered for Mr. Burbank's experiments.

12396. Physalis sp. **Purple ground cherry.**

From Columbus, Ohio. Received thru the Livingston Seed Company, December 24, 1904.

12397. Zinnia elegans. **Zinnia.**

From Naples, Italy. Received thru Mr. Max Herb, successor to Herb & Wulle, 24–36 via Trivio, December 24, 1904.

Zinnia elegans, fl. pl. crispa, extra; described in volume 19 of Möller's Deutsche Gärtner-Zeitung, p. 475.

12398. Medicago sativa. **Alfalfa.**

From Fort Collins, Colo. Received thru Mr. Peter Anderson, December 28, 1904.

12399 and 12400. Glycine hispida. **Soy bean.**

From Amherst, Mass. Received thru the Hatch Experiment Station, December 28, 1904.

12399. Grown from S. P. I. No. 9407.

12400. Grown from S. P. I. No. 9408.

12401. Ipomoea sp.

From Miami, Fla. Received thru Prof. P. H. Rolfs, Subtropical Laboratory, December 23, 1904.

A pink-flowered Ipomœa grown from seed secured by Professor Rolfs in Cuba or Jamaica.

12402 and 12403. Opuntia ficus-indica gymnocarpa. **Tuna.**

From Nice, France. Received thru Dr. A. Robertson-Proschowsky, December 27, 1904.

"In a letter of December 12, Doctor Proschowsky remarks: 'The young joints of this species have small spines, but these fall off in the second year. As regards the fruits, it is three years that they have been produced in my garden, and they have always been absolutely spineless without any of those almost microscopic spicules which are the great objection to the fruits of Opuntia in general.' The present year only three fruits were developed, and the seeds sent, No. 12403, are from one of those fruits. As this small number of seeds represents the total number contained in the fruit it is evident that the variety, in addition to bearing spineless fruits, bears fruits with comparatively few seeds in them. Doctor Proschowsky further remarks that this Opuntia is the largest, quickest growing, and most picturesque of all of the Opuntias which he has ever seen." (*Fairchild.*)

12404. Cereus validus.

From Nice, France. Received thru Dr. A. Robertson-Proschowsky, December 27, 1904.

"A tall, picturesque plant, which produces fruit the size of a goose egg and of a beautiful magenta color. These fruits are absolutely without spicules and of very good taste. Doctor Proschowsky remarks that he knows of no other fruit which is so 'melting,' and it resembles much the 'snows' sold in Latin-American countries, consisting of real snow mixed with some fruit juice or sugar." (*Fairchild.*)

12405 to 12407.

From New York, N. Y. Received thru J. M. Thorburn & Co., December 28, 1904.

12405. Holcus lanatus. **Velvet grass.**

A forage grass of poor quality, but capable of growing well on dry soil.

12405 to 12407—Continued.

12406. SPERGULA ARVENSIS. **Spurry.**

An annual plant of especial value on dry, sandy land.

12407. ORNITHOPUS SATIVUS. **Serradella.**

An annual legume for growing on dry, sandy land.

12408. ULEX EUROPAEUS. Gorse, whin, or furze.

From Dublin, Ireland. Received thru Hogg & Robertson, December 29, 1904.

"The cultivation of this plant is suited only to waste lands which are unfit for more profitable cultures. In portions of northern France, the Netherlands, England, and Ireland the plant is utilized successfully as fodder, being cut and passed thru a special shredding machine, which reduces the spines to a harmless pulp. In the Madeira Islands, J. B. Blandy informed me that it was very keenly relished by cattle and furnished an excellent fodder for milk-producing purposes. The plant, altho not a tender species, will probably not be hardy in the Northwest, but should be tried in regions with a climate similar to that of England and Ireland, on rocky, barren hillsides where other plants will not thrive." (*Fairchild.*)

12409. MEDICAGO SATIVA. Alfalfa.

From Ogden, Utah. Received thru the C. A. Smurthwaite Produce Company, December 30, 1904.

This seed was grown on the ranch of Mr. E. M. Brimall, Diamond Fork, Spanish Fork Canyon, Utah County, Utah, on land without irrigation, above water line in section 1, township 9 south, range 4 east. This land has grown alfalfa seed for nineteen years in succession, and this seed is from the nineteenth crop.

12410 to 12448.

Drug and medicinal seeds and plants ordered for the cooperative work conducted by Dr. R. H. True, of this Department.

12410 to 12422.

From Paris, France. Received thru Vilmorin-Andrieux & Co., 4 Quai de la Mégisserie, December 29, 1904.

12410. ACONITUM NAPELLUS.

12411. ACONITUM NAPELLUS.

12412. HYOSCYAMUS NIGER.

12413. LAVANDULA VERA.

12414. CARUM CARUI.

12415. PYRETHRUM ROSEUM.

12416. PYRETHRUM CINERARIAEFOLIUM.

12417. THYMUS VULGARIS.

12418. ROSMARINUS OFFICINALIS.

12419. SATUREJA HORTENSIS.

12420. DELPHINIUM STAPHISAGRIA.

12421. ECBALLIUM ELATERIUM.

12422. ORIGANUM VULGARE.

12423. SALVIA OFFICINALIS. **Sage.**

From Philadelphia, Pa. Received thru W. Atlee Burpee & Co., November 30, 1904.

Broad-leaved.

12424 and 12425. ECHINACEA ANGUSTIFOLIA.

From Manhattan, Kans. Received thru Mr. H. W. Baker, November 28, 1904.

12424. Plants.

12425. Seeds.

12410 to 12448—Continued.

12426 to 12441.

From Erfurt, Germany. Received thru Haage & Schmidt, December 24, 1904.

12426. Ecballium elaterium.
12427. Aconitum napellus.
12428. Aconitum napellus.
12429. Hyoscyamus niger.
12430. Lavandula vera.
12431. Carum ajowan.
12432. Origanum vulgare.
12433. Delphinium staphisagria.
12434. Pyrethrum roseum.
12435. Pyrethrum cinerariaefolium.
12436. Colchicum autumnale.
12437. Thymus vulgaris.
12438. Rosmarinus officinalis.
12439. Satureja hortensis.
12440. Bryonia alba.
12441. Bryonia dioica.

12442. Cassia angustifolia. **Senna.**

From Corpus Christi, Tex. Received thru Mr. H. H. Fisher, October 31, 1904.

12443 to 12446. Panax ginseng. **Ginseng.**

From Cuba, N. Y. Received thru Bates Ginseng Gardens, October 31, 1904.

12443. One-year-old roots.
12444. Two-year-old roots.
12445. Three-year-old roots.
12446. Germinated seed.

12447. Monarda fistulosa. **Wild bergamot.**

From Rochester, Mich. Received thru Mr. Wilfred A. Brotherton, November 14, 1904.

12448. Monarda punctata. **Horsemint.**

From La Crosse, Wis. Received thru Dr. E. C. Swarthout, October 28, 1904.

12449 and 12450. Dahlia spp. **Dahlia.**

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, December 27, 1904.

Seeds collected near Ixtlahuacan del Rio, Jalisco, Mexico, northwest from Guadalajara.

12449. White.
12450. Striped.

12451. Eutrema wasabi. **Japanese horse-radish.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company, December 29, 1904.

(Described in detail in Bulletin No. 42 of the Bureau of Plant Industry.)

12452. Aralia cordata. **Kan udo.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company, December 29, 1904.

(For description, see Bulletin No. 42 of the Bureau of Plant Industry.)

12453 to 12547. ORYZA SATIVA. **Rice.**

"Samples of rice received in answer to requests made of the various persons furnishing same, for testing in connection with the efforts now being made for the purpose of finding a variety resistant to the disease known as rotten-neck, threatening the rice-growing industry in the Carolinas." (*Fairchild.*)

12453 to 12463. **Rice.**

From Paris, France. Presented by Vilmorin-Andrieux & Co. Received July 29, 1904.

Samples of unhulled rice as follows:

12453. *Piemontese* rice, *Novarese.* One of the most valued for its yield and its quality. It is, however, grown in Lombardy on soil only which has carried a rice crop the previous season, as on fresh land it easily takes the disease called "brusone."

12454. *Piemontese* rice, *Bertone.* Usually grown on fresh land, is resistant to the "brusone," and the hulled rice is inferior to the *Novarese.*

12455. *Piemontese* rice, *Javanese.* Thrives on all kinds of land. It is pretty resistant to "brusone," but is very late, lacks quality and sheds its seeds too easily when being cut.

12456. *Piemontese* rice, *nostrano.* Takes too easily the disease "brusone," and is consequently little grown in Lombardy. It is somewhat used in the perpetual rice fields of the Po Valley, where it seems to be more resistant.

12457. *Piemontese* rice, *leoncino.* Very productive Japanese rice, of good quality, with a golden spike. Recommended for wet, compact, rich land.

12458. *Piemontese* rice, *francone.*

12459. *Egyptian* rice, *fino.*

12460. *Egyptian* rice, *sultanie.*

12461. *Egyptian* rice, *yamani.*

12462. *Dry Mountain* rice.

12463. Dry rice from Manchuria.

12464 to 12478. **Rice.**

From Colombo, Ceylon. Presented by Dr. C. Drieberg, superintendent of School Gardens. Received October 21 and 24, 1904.

12464. *Kurusivru* paddy. White grain in black husk. From Kegalle district.

12465. *Muttusamba* paddy. Superior variety for table use. From Kegalle district.

12466. *Kaiurusamba* paddy. From Kegalle district.

12467. *Kirinaran* paddy. From Bentota district.

12468. *Suduve* paddy. From Bentota district.

12469. *Yal-tatu-hel* paddy. From high elevation, Uva Province.

12470. *Mudu-kiri-hel* paddy. From high elevation, Uva Province.

12471. *Ceylon Carolina* paddy. From Hauwella, 30 miles inland from Colombo.

12472. *Ceylon Carolina* paddy. From Mount Lavinia, 7 miles south of Colombo.

12473. *Kiusui* (Japanese) paddy. Grown in the Government Stock Garden.

12474. *Ingrese we.* From Elakake, 4 miles inland from Bentatte, about halfway from Colombo to Galle.

12475. *Kuru-vi* paddy. From Madampe, Northwestern Province.

12453 to 12547—Continued.

12464 to 12478—Continued.

12476. *Rata-vi* paddy. From Madampe, North Central Province. Somewhat mixed with native varieties.

12477. *Puluk-hsmban* paddy. From Kegalle district.

12478. *Rat-hel* paddy. Up-country grain, inclined to be white, tho husk is rather dark.

12479 to 12488. **Rice.**

From Singapore, Straits Settlements. Presented by Mr. R. Derry, assistant superintendent of the Botanical Gardens. Received November 9, 1904.

12479. *Arong* paddy. Used for making flour, and when cooked is hard and white. Always used by the natives.

Mr. Derry uses the term "paddy" to signify wet-land rice, and the term "pulot" to indicate dry-land rice.

12480. *Krencho* (or *Keroncho*) paddy. Used same as 12479; price same also.

12481. *Chemara-putri* paddy. Used same as 12479; price same also.

12482. *Seri-bumi* paddy. First-class flour for making cakes; pure white when cooked.

12483. *Seroupe* paddy. First-class flour for cakes and for the natives.

12484. *Radin* paddy. Used for rice by the natives.

12485. *Bunga-melong* pulot. Used for making cakes of any kind, but when cooked is hard and white.

12486. *Seong-ular* pulot. Use and price same as 12485.

12487. *Merah* pulot (or paddy). Use and price same as 12485.

12488. *Manek* paddy. Used only for feeding turtledoves and ringdoves.

12489 to 12512. **Rice.**

From Georgetown, Demerara, British Guiana. Presented by Mr. B. Howell Jones. Received in August, 1904.

12489. Rice of the kind usually grown in British Guiana.

12490 to 12511.

Samples experimentally grown at the Georgetown Botanical Gardens from imported Ceylon rice. They are distinguished by number only. Nos. 12490 to 12503 are "Ordinary rice." Nos. 12504 to 12511 are what are known as "Hill rice."

12512. From the Berbice River district.

12513 to 12515. **Rice.**

From Bulkeley, Ramleh, Egypt. Presented by Hon. Lionel Sandars. Received during the summer of 1904.

12513. *Yaban* (or *Yapani*) paddy. From Daira Draneht Pasha, Kafr-el-Dawar.

12514. *Soultani* (or *Sultani*) paddy. Same source as 12513.

12515. *Sabaini* (or *Sabini*) paddy. Same source as 12513.

12516 to 12518. **Rice.**

From Siam. Presented by the Arracan Company, of Bangkok, thru Dr. T. Heywood Hays, of that place. Received October 21, 1904.

12516. *Naichonchisee* paddy. Usually considered the finest quality in Bangkok.

12517. *Sakakrang* paddy. Good quality; long grain.

12518. *Paknampho* paddy. Medium quality.

12453 to 12547—Continued.

12519 to 12520. **Rice.**

From Italy. Presented by Messrs. Dammann & Co., San Giovanni a Teduccio, near Naples. Received October 3, 1904.

12519. *Italian.* No special name given.

12520. *Italian.* No special name given; probably the same kind as 12519.

12521. *Thessaly.* **Rice.**

From Greece. Presented by Mr. S. Xanthopaulo, Station Agricole, Patras. Received in August, 1904.

12522. **Rice.**

From Brazil. Presented by Consul Louis H. Aymé, Pafa. Received in August, 1904.

Rice paddy, like that grown in the districts of Guama and Irituba, in the State of Maranhac, Brazil, in a black loam, either overlying or mixt with sandy gravel and sandstone. The rice is called *Carolina.*

12523 and 12524. **Rice.**

From German East Africa. Presented by Mr. Udo von Katte, Plantage Kigome, Bezirk Tanga. Received October 5, 1904.

12523. *Nondro* paddy.

12524. *Kikanda* paddy.

12525 to 12547. **Rice.**

From Java. Presented by Mr. Charles A. Franc, Soerabaya, Java, Dutch East Indies. Received November 17, 1904.

12525 to 12540. *Ampenan* paddy.

12541. *Magetan* paddy.

12542. *Pekalongan* paddy.

12543. *Pekalongan* paddy.

12544. *Solo "A"* paddy.

12545. *Solo "B"* paddy.

12546. *Djember* paddy.

12547. *Djember* paddy.

12548. CRATAEGUS sp. (?)

From City of Mexico, Mexico. Received from Mr. G. Clark, thru Mr. G. Onderdonk, of Nursery, Tex., December 31, 1904.

This species of *Crataegus* is used in different parts of Mexico as a stock upon which the European and American type of pears are grafted. In a letter of May 30, 1904, Mr. Onderdonk describes the use of this stock as follows: "While there is to be found an occasional young *tijocate* growing in a cultivated lot with intention of being made a stock for pears by grafting where it stands, yet no nurseries of it exist. It grows wild in the most forbidding situations. The earliest fruits begin to ripen about the last of July, while the largest number mature about October or November. I saw many fine old pear trees in different parts of Mexico on *tijocate* stock, and for the European and American type of pears there can be *no better stock than tijocate.*"

12549. MEDICAGO SATIVA. **Alfalfa.**

From Buenos Aires, Argentina. Received thru Mr. Ronaldo Tidblom, August 12, 1905.

12550. POA PRATENSIS. **Kentucky bluegrass.**

From Winchester, Ky. Received thru Mr. D. S. Gay, December 2, 1904.

12551. (Undetermined.)

From Central Africa. Presented by Mrs. Anita N. McGee, 1620 P street, Washington, D. C. Received thru Mr. David Fairchild, December 31, 1904.

A single plant, said to be the first of its kind ever brought to America and to belong to the order Scitamineae. The plant was introduced by Mr. Vernon, who brought the Pigmies to the Louisiana Purchase Exposition. (*Fairchild.*)

12552. AMYGDALUS COMMUNIS. **Almond.**

From Niles, Cal. Received thru the California Nursery Company, January 4, 1905.

Jordan. "These trees are from stock introduced by Mr. John Rock, seed of which was submitted to the United States consul in Malaga, and pronounced the true Jordan type. They are not from trees of stocks introduced by this Department." (*Fairchild.*)

12553 to 12556. TERMINALIA sp. **Myrobalan.**

From New York, N. Y. Received thru A. Klipstein & Co., 122 Pearl street, July 11 and August 1, 1904.

12553. *Jubblepore,* No. 1.

12554. *Bhimleys,* No. 2.

12555. *Jubblepore,* No. 1.

12556. *Bimley,* No. 2.

"The fruits of the myrobalan contain one of the best tanning substances in the world. Large quantities of myrobalans are exported from India to England, and it is believed that the cultivation of these trees, of which there are evidently several species, may be a lucrative one in parts of California. The tree is known to be a drought-resistant species and suited to extremely hot climates. Some of the species are trees and, consequently, may withstand the slight cold to which they will be subjected in California." (*Fairchild.*)

12557 and 12558. ZEA MAYS. **Sweet corn.**

Selected seed corn for use in a series of experiments to determine the effect of soil, location, etc., on standard varieties of sweet corn, the idea being to distribute this seed to reliable parties in different localities, and to secure from them samples of the product for examination and further distribution.

12557. Received from Mr. A. N. Clark, Milford, Conn., March 25, 1904.

Stowell's Evergreen.

12558. Received from Mr. A. N. Clark, Milford, Conn., March 25, 1904.

Early Crosby.

12559 to 12561. ZEA MAYS. **Sweet corn.**

From Falls Church, Va. Received thru Mr. Upton Galligher, March 25, 1904.

12559. *Malakof.* Grown in 1903 from S. P. I. No. 9357.

12560. *Malakof.* Selected ears.

12561. *Malakof.* Grown in 1903 from S. P. I. No. 9356

12562. ZEA MAYS. **Sweet corn.**

From Auburn, N. Y. Received thru Mr. G. W. Boynton, May 6, 1904.

Malakof. Seed from selected amber ears, probably from same lot as S. P. I. No. 10401.

12563. ZEA MAYS. **Sweet corn.**

From Garrettsville, Ohio. Received thru Mr. George J. Streator, May 6, 1904.

Malakof. Seed from selected ears.

12564. DAHLIA sp. **Dahlia.**

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, December 30, 1904.

12565. LILIUM sp. **Lily.**

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, January 4, 1905.

12566 to 12576.

From Tunis, North Africa. Secured by Mr. Thomas H. Kearney during his exploration of Tunis. Received January 4, 1905.

A collection of economic plants as follows:

12566 to 12568. PUNICA GRANATUM. **Pomegranate.**

From the premises of M. Robert, Kalaâ Srira, Susa.

12566. Red fruited.

12567. *Chelfi.* White fruited.

12568. White-fruited variety from Gabes.

"These pomegranates are the best sorts grown in Tunis. The first two seem to be peculiar to Susa." (*Kearney.*)

12569 to 12573. OLEA EUROPAEA. **Olive.**

From the premises of M. Robert, Kalaâ Srira, Susa.

12569. *Baroumi* (fruit mucronate).

12570. *Baroumi* (fruit not mucronate).

"This is the largest olive in the country, and M. Robert's is about the only place where it can be secured." (*Kearney.*)

12571. *Zarazi* (?).

"This is a medium-sized olive and is the most-generally planted preserving olive in the country, being common even to the oases of the Jerid. It is probably a hardy sort, and one easily adapted to a variety of conditions. As soon as I see M. Minangoin I shall find out definitely if it is actually the *Zarazi* that I have obtained." (*Kearney.*)

12572. *Bidh Hammam.*

This is one of the largest olives of Tunis.

12573. *Chemlali.* From Sfax, Tunis.

"It is doubtful if this is a desirable sort, as the oil produced from it is said to contain too much margarin." (*Kearney.*)

12574 to 12576. MESEMBRYANTHEMUM spp.

From Sfax, Tunis.

12574. With yellow flowers.

12575. With rose-colored flowers.

12576. With rose-violet flowers.

"The first two kinds are used here as border plants, and also for holding banks at roadsides, while the last is made use of in the Jardin Publique as a lawn plant. These grow well in this dry soil without attention after the first two weeks after planting." (*Kearney.*)

12577. POTERIUM SANGUISORBA. **Burnett.**

From New York, N. Y. Received thru J. M. Thorburn & Co., January 5, 1905.

12578 to 12668. SOLANUM TUBEROSUM. **Potato.**

From Europe. Secured by Prof. L. R. Jones, of the University of Vermont, during a trip thru the potato-growing regions of Europe in 1904. Notes by Professor Jones.

12578 to 12596.

From Berlin, Germany. Received thru the Potato Culture Station, December 14, 1904.

12578.

Geheimrat Theil. (L. R. Jones's No. 1.) Originated by Richter. Skin white, flesh white. (See description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, p. 53.)

Recommended by Professor Eckenbrecher and independently by his foreman, Mr. Goese, as showing a high degree of disease resistance and being a good general-purpose potato.

12578 to 12668—Continued.

12578 to 12596—Continued.

12579.

Sophie. (L. R. Jones's No. 2.) Originated by Cimbal. White skin, yellowish-white flesh. (See description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, pp. 37 and 53.)

Recommended by Professor Eckenbrecher as one of the most productive of table varieties. Fairly resistant to disease; suited to various soils.

12580.

Dabersche. (L. R. Jones's No. 3.) Originator unknown. Skin pale red, flesh white-yellowish. (For further notes, see any of reports of Deutsch. Kart.-Kult.-Stat., e. g., 1903, pp. 34 and 53.)

This was ordered because it is the standard table variety in the trials of the German station. It is one of the most widely cultivated food potatoes in Germany; an old variety. Professor Eckenbrecher reports it as most liable to scab and liable to rot.

Sorauer says that it is suited to sandy soils. Foreman Goese says it is not suitable for heavy soils. Doctor Appel finds it one of the most resistant to "Schwarzbeinigkeit."

12581.

Richter's Imperator. (L. R. Jones's No. 4.) Originated by Richter. Skin white, flesh white. (For description, see any report of the Deutsch. Kart.-Kult.-Stat., e. g., 1903, pp. 35 and 52.)

Chosen for two reasons: (1) It is one of the most uniformly resistant to scab of the varieties reported upon by Professor Eckenbrecher for a long series of years. (2) It is taken at this German station as the typical heavy yielding factory potato. It is also a fair table variety. Not especially resistant to disease except scab; suited to all except wetter soils.

12582.

Magnum Bonum. (L. R. Jones's No. 5.) Originated by Sutton. Skin white, flesh white; a medium late variety which is a standard table potato of north central Europe. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, pp. 43 and 53.)

Prunet, Frank, Sorauer, and others report this to be the most resistant to Phytophthora of any variety. Suited to all soils, according to Foreman Goese.

12583.

Irene. (L. R. Jones's No. 6.) Originated by Paulsen. Skin red, flesh white. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, pp. 39 and 43.)

A medium late variety which has been found in the trials of this station second only to *Mohort* in resistance to diseases (rots, etc.). It is also very resistant to scab. According to Foreman Goese, suited to good soils but not to light sands.

12584.

Professor Maerker. (L. R. Jones's No. 7.) Originated by Richter. Flesh white. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1897, p. 29; 1903, pp. 42 and 52.) This is a medium late variety, exceedingly productive, and a favorite sort in Germany for factory purposes, as well as a good table variety. It has shown good scab resistance, and was recommended by Foreman Goese and Professor Eckenbrecher for general disease resistance. Foreman Goese says that it is suited to all soils.

12585.

Silesia. (L. R. Jones's No. 8.) Originated by Cimbal. Flesh and skin white. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1899, p. 35; 1903, p. 42.)

12578 to 12668—Continued.

12578 to 12596—Continued.

A very late variety. Very heavy yielder and high percentage of starch, therefore one of the highest in total starch product. Only fairly resistant to disease, but included upon recommendation of Professor Eckenbrecher. Foreman Goese says that it is suited to all soils.

12586.

Max Eyth. (L. R. Jones's No. 9.) Originated by Cimbal. This is a late potato, of good quality and starch content, described in the Berichte Deutsch. Kart.-Kult.-Stat.

Ordered because Foreman Goese stated that he considered this the most resistant variety toward Phytophthora, and added that it is suited to all soils.

12587.

Mohort. (L. R. Jones's No. 10.) Originated by Dolkowski. White skin, white flesh. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, pp. 37 and 42.)

Selected because reported (1903, etc.) as the most highly resistant to diseases (rot, etc.) of any variety tested; also fairly resistant to scab. Excellent table variety; high yielder; high starch content. Foreman Goese says that it is suited to all soils.

12588.

Gastold. (L. R. Jones's No. 11.) Originated by Dolkowski. White skin, white flesh, middle late. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, pp. 35 and 42.)

Selected because next to *President Krüger* this appears to be the most productive variety they have. Fair degree of general disease resistance. Esteemed alike for table and factory. Foreman Goese says that it is suited to all soils.

12589.

President Krüger. (L. R. Jones's No. 12.) Originated by Cimbal. White skin, white flesh, late variety. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, pp. 35, 42, and 52.)

Selected because it has proved to be an enormous yielder, leading all varieties in most trials. It is of rather low starch content and recommended only for factory purposes. Foreman Goese says that it is suited to all good soils.

12590.

Professor Wohltmann. (L. R. Jones's No. 13.) Originated by Cimbal. Skin red, flesh white. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1900, p. 35; 1903, pp. 43 and 52.) Late variety.

Selected because reported as highly resistant to scab. Large yielder and high starch content. Esteemed both for factory and table purposes. Foreman Goese says it needs a good, rich soil.

12591.

Topas. (L. R. Jones's No. 14.) Originated by Dolkowski. Skin white, flesh white. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1900, p. 35; 1903, p. 42.) Medium early.

According to reports a good disease-resistant sort, good yielder, rich in starch, suitable for table and factory use.

Selected because Doctor Appel observed in 1902 that this showed the highest degree of resistance to Phytophthora of any variety in his fields. (See his article, "Die diesjährige Phytophthora-Epidemie," Deutsche Landw. Presse, XXIX, 685.) Foreman Goese says that it is suited to all soils.

12592.

Boncza. (L. R. Jones's No. 16.) Originated by Dolkowski. Skin red, flesh white, medium late. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1901, p. 36; 1903, p. 42.)

12578 to 12668—Continued.

12578 to 12596—Continued.

This is not a very large yielder, but is very rich in starch (excelled all others in 1901); a very good table variety.

According to 1901 reports it is most highly resistant to disease (rots, etc.) and also resistant to scab. Selected because of this. Mr. Goese says that it is suited to all soils.

12593.

Leo. (L. R. Jones's No. 17.) Originated by Pflug. Skin white, flesh white, medium late. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1902, p. 35; 1903, pp. 42 and 52.)

This is not especially disease resistant, but was included upon recommendation of Professor Eckenbrecher, since it is one of the heaviest yielding varieties of high starch content and therefore very high total starch product on the average.

Medium late. Especially a factory variety, but also a good table potato. Mr. Goese says that it is similar to Richter's *Imperator*, and suited to all except moist soils.

12594.

Fuerst Bismarck. (L. R. Jones's No. 18.) Originated by Cimbal. Skin red, flesh white, late. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1901, p. 37; 1903, p. 43.)

Exceedingly rich in starch and fair yielder. Recommended both for factory and table use. Professor Eckenbrecher has found this especially free from rot (Berichte, 1899), and it is included upon his recommendation for disease resistance. Mr. Goese says that it is suited for all good soils, but not for sand.

12595.

Apollo. (L. R. Jones's No. 19.) Originated by Paulsen. Skin white, white-yellowish. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1901; also 1903, pp. 36 and 53.)

Highly productive for starch content; recommended first for factory use, but also as a table variety. Here included upon the personal recommendation of Professor Eckenbrecher, who has found, during three years' trials, that it is highly resistant to disease (rots, etc.) and fairly resistant to scab. Mr. Goese says that it is suited to all soils.

12596.

Gelbfleischige Speisekartoffel. (L. R. Jones's No. 20.) Originated by Cimbal. Skin white, flesh yellowish, rather late ripening. (See further description in Berichte Deutsch. Kart.-Kult.-Stat., 1903, pp. 40 and 53.)

This is a medium yielder, not recommended at all for factory purposes but as an excellent yellow-fleshed table potato. Included for this reason. It is reputed as rather susceptible to diseases. Mr. Goese says that it is suited to all soils.

12597 to 12601.

From Groningen, Holland. Received thru Mr. U. J. Mansholt, rijksbauwleeraar, November 30, 1904.

12597.

Eigenheimer. (L. R. Jones's No. 31.) Recommended by Mr. Mansholt as an early yellow-fleshed variety, good for table use, and resistant to Phytophthora.

12598.

Landskroon. (L. R. Jones's No. 32.) Recommended by Mr. Mansholt as a middle early white-fleshed potato, good for table use, and resistant to Phytophthora.

12599.

Eureka. (L. R. Jones's No. 33.) Recommended by Mr. Mansholt as a middle early variety for factory rather than table use, and resistant to Phytophthora.

12578 to 12668—Continued.

12597 to 12601—Continued.

12600.

Malador. (L. R. Jones's No. 34.) Recommended by Mr. Mansholt as a late, yellow-fleshed, good table variety, and resistant to Phytophthora.

12601.

Daisy. (L. R. Jones's No. 35.) Recommended by Mr. Mansholt as a late factory variety and resistant to Phytophthora.

12602 to 12607.

From Paris, France. Received thru Vilmorin-Andrieux & Co., September 22, 1904.

12602.

Belle de Fontenay. (L. R. Jones's No. 36.) Recommended by Vilmorin-Andrieux & Co. as a very early variety of high vigor and productiveness. Tubers oblong, skin and flesh yellow. Esteemed one of the best early potatoes; the standard in the Paris market. Stands shipment well and esteemed for "French fried" potatoes; prefers a fairly moist soil in France; recommended especially for trial in the South.

12603.

Brandale. (L. R. Jones's No. 37.) Recommended by Vilmorin-Andrieux & Co. as a very early variety with oblong tubers, yellow skin and yellow flesh, and worthy of trial in Florida.

12604.

Early Rose. (L. R. Jones's No. 38.) This is very extensively grown as an early potato in France, and is the only white-fleshed early potato Vilmorin-Andrieux & Co. could recommend. They consider it of high vigor and productiveness.

12605.

Chave (Shaw). (L. R. Jones's No. 39.) This is a standard French variety, round tubers, yellow flesh, and yellow skin. Recommended by Vilmorin-Andrieux & Co. as of high vigor and productiveness and worthy of trial in our Southern States.

Doctor Delacroix considers this the most resistant of the French varieties to Phytophthora and similar in this respect to *Magnum Bonum* among the English varieties.

12606.

Belle de Juillet. (L. R. Jones's No. 40.) Second early. Oblong tubers, skin and flesh yellow. Recommended for trial, especially in the South, by Vilmorin-Andrieux & Co. as an especially vigorous and productive variety. "I found what I take to be the same variety to be the favorite potato grown at Florence (Experiment Farm), for the northern export and trade. It is also grown and highly esteemed in Germany." (*Jones.*)

12607.

Quarantaine de la Halle. (L. R. Jones's No. 42.) This was described as a medium-early variety of high vigor and productiveness, recommended for trial culture in Florida, etc. Oblong tubers, skin and flesh yellow.

12608 to 12613.

From Reading, England. Received thru Sutton & Sons, December 31, 1904.

12608.

May Queen. (L. R. Jones's No. 51.) Sutton's origination. Very early; kidney shape, shallow eyes, yellow skin, a very handsome potato,

12578 to 12668—Continued.

12608 to 12613—Continued.

and reputed as of high quality and fair yield for so early a variety. Recommended by Sutton and various others as worthy of trial in Florida. Mr. Scarlett advises to plant whole tubers and rather close together, as tops are small.

12609.

Ninetyfold. (L. R. Jones's No. 52.) Originated by Sutton. "First early;" white skin and flesh. Good kidney shape but not quite so uniform and handsome as *May Queen,* and eyes somewhat deeper. Rated a better cropper. A good authority states "one of heaviest croppers among the first earliest; therefore profitable to grow, although quality is not of best." Opinions differ as to disease resistance. Various persons recommend this for trial in Florida, etc.

12610.

Epicure. (L. R. Jones's No. 53.) Originated by Sutton. A "second early" variety; bronzy red skin; flesh white; recommended highly by Sutton, but this is not indorsed by all others consulted. Secured especially for trials in South.

12611.

Supreme. (L. R. Jones's No. 54.) Originated by Sutton & Sons. A "second early," but a little earlier than *Epicure.* White. This makes a small top and is not altogether promising. It was, however, recommended by the Suttons for trial, especially in the South. It seemed comparatively free from "Schwarzbeinigkeit," as seen at Cambridge, England.

12612.

Windsor Castle. (L. R. Jones's No. 55.) A "second early" variety; yellow skin, white flesh, roundish, recommended by the Suttons as highest quality for table. It was also indorsed by others as worthy of trial, especially in the South.

12613.

Discovery. (L. R. Jones's No. 56.) This is one of Sutton's latest originations. It is medium late, yellow skin, white flesh, kidney shape, excellent quality and strong yielder. Sutton's people rate it as their greatest production, and the opinion of unbiased potato experts so far as consulted is that this is the most promising disease-resistant potato in England to-day.

12614 to 12619.

From Edinburgh, Scotland. Received thru Mr. T. A. Scarlett, December 31, 1904.

12614.

Sir John Llewellyn. (L. R. Jones's No. 57.) This is recommended most highly of all early potatoes in England.

Recently introduced by Harris, Wales; season is "first early;" white skin, white flesh, flattish-oval kidney shape, fine appearance and strong cropper, quality not of best; likes a good soil, and is a strong feeder. Said to have a tendency to develop sports. This is noteworthy, since it may prove more promising for selection of disease-resistant plants.

12615.

King Edward VII. (L. R. Jones's No. 58.) This is one of recently originated varieties. Sent out by Butler. Late second early. Pink skin, flesh white, said to yellow somewhat when cooked. Said to be productive but not of highest quality. Ordered on recommendation of W. P. Wright, secretary of the National Potato Society. Most other opinions given were adverse to its value as a disease resister.

12578 to 12668—Continued.

12614 to 12619—Continued.

12616.

Cramond Blossom. (L. R. Jones's No. 59.) Of recent origin in the Scotch village of Cramond. Season, "late second early." Oval. Recommended for our trials as a disease-resistant variety by W. P. Wright, secretary of the National Potato Society, but this opinion was not concurred in by several others. Mr. Scarlett finds it liable to disease; so also do the Suttons and Middleton.

12617.

Charles Fidler. (L. R. Jones's No. 60.) Recent origin, sent out by Fidler. This is a late potato, white, said by Mr. Lasham to be practically the same as the German variety *Imperator*, if not identical with that sort. Recommended as worthy of trial for disease resistance both by Mr. W. P. Wright, secretary of the National Potato Society and by men at the Cambridge University farm.

12618.

Factor. (L. R. Jones's No. 61.) This is one of the newer varieties sent out by Dobbie. It is late; very well spoken of by all. Closely resembles the popular standard *Up-to-Date*, but said to be of slightly better quality. Recommended for our trial by W. P. Wright, secretary of the National Potato Society; also by men at the Cambridge University farm, etc.

12619.

Duke of York. (L. R. Jones's No. 62.) This is one of the highly esteemed earlier varieties, recommended especially by the Cambridge University farm authorities. Also well spoken of by Mr. Scarlett.

12620 to 12642.

In addition to Jones's Nos. 57 to 63, ordered from Mr. Scarlett, the latter was authorized to include various others of the most promising Scotch potatoes which he judged worthy of trial. In accordance therewith, he included the following 23 varieties:

12620. *Langworthy.*
12621. *Tyne Kidney.*
12622. *Table Talk.*
12623. *Dalmeny Kidney.*
12624. *Crofter.*
12625. *Scottish Queen.*
12626. *Premier.*
12627. *Northern Star.*
12628. *Pink Blossom.*
12629. *Peacemaker.*
12630. *Dalmey Red.*
12631. *Dalmey Early.*
12632. *Sharpe Express.*
12633. *Midlothian Early.*
12634. *Southern Queen.*
12635. *Wylun Early.*
12636. *White Blossom.*
12637. *Red Kidney.*
12638. *Moneymaker.*
12639. *Sir Thomas Lipton.*
12640. *Radium.*
12641. *Acme.*
12642. *Heather Blossom.*

12643 to 12668.

From Cambridge, England. Received thru Mr. H. Henshaw, of Cambridge University farm, December 14, 1904.

12643. *Sutton's Discovery.*
12644. *Sutton's Supreme.*
12645. *Sutton's Ideal.*
12646. *Sutton's Flour Ball.*
12647. *Sutton's Ninetyfold.*
12648. *Findlay's Evergood.*
12649. *Findlay's Goodfellow.*

12578 to 12668—Continued.

12643 to 12668—Continued.

12650. *Findlay's Up-to-Date.*

12651. *Findlay's Northern Star.*

12652. *Findlay's British Queen.*

12653. *Fidler's Seedling.*

12654. *Charles Fidler.*

12655. *Carter's Snowball.*

12656. *Carter's Monarch.*

12657. *Kerr's Dumfries Model.*

12658. *Kerr's Duchess of Cornwall.*

12659. *Dobbie's Factor.*

12660. *Dobbie's Improved Kidney.*

12661. *Butler's King Edward VII.*

12662. *Sir John Llewellyn.*

12663. *Cramond Blossom.*

12664. *Langworthy.*

12665. *Duke of Rothesay.*

12666. *Royal Kidney.*

12667. *Duke of York.*

12668. *Empress Queen.*

12669. CUCUMIS MELO. **Muskmelon.**

From Boston, Mass. Received thru R. & J. Farquhar & Co., January 6, 1905.

Montreal Nutmeg.

12670. ULEX EUROPAEUS. **Gorse, whin, or furze.**

From Dublin, Ireland. Received thru Hogg & Robertson, January 6, 1905.

"Fresh roots covered with root tubercles, imported in cooperation with the Laboratory of Plant Physiology for the purpose of getting cultures of the micro-organism of these tubercles to be used in experiments in the introduction of the plants, the seed of which was introduced under No. 12408." (*Fairchild.*)

12671. MEDICAGO SATIVA. **Alfalfa.**

From Lawrence, Kans. Received thru F. Barteldes & Co., January 6, 1905.

12672 to 12677. OLEA EUROPAEA. **Olive.**

From Tunis, North Africa. Secured by Mr. Thomas H. Kearney. Received January 6, 1905. A collection of olive cuttings from the premises of M. Robert, Kalaâ Srira, Susa.

12672. *Souaba el Aljia.* An oil olive. Rather a small yielder, according to Minangoin.

12673. *Chaibi.* An uncommon but heavy yielding variety of oil olive that succeeds best in northern Tunis.

12674. *Semni* (butter). An olive which remains yellow green even when ripe; gives oil of very light color but of finest quality.

12675. *Khadraya* (green). An oil olive.

12676. *Kalb es Serdouk* (cock's heart). A small oil olive like Chemlali, yielding very heavily, adapted to dry lands.

12677. *Nebkri.* Gives oil of finest quality.

12678. PANICUM MAXIMUM. **Guinea grass.**

From Havana, Cuba. Received thru José Sagarminaga, seedsman, Obispo 66. January 7, 1905.

12679. ORYZA SATIVA. **Rice.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company, January 5, 1905.

Sekai-ichi, meaning the "World's No. 1," grown in Iyo, Shikoku Province, which received the first prize in the last Osaka exposition and is recommended as the best and nearest quality to the *Carolina Golden* by Mr. Kenzo Ikeda, the president of the Agricultural Society of Japan. (*Fairchild.*)

12680. LILIUM PARDALINUM. **Lily.**

From Ukiah, Cal. Received thru Mr. Carl Purdy, January 5, 1904.

This lily is native to the Coast Range of mountains in California and Oregon. It is found at elevations varying from 1,000 to 5,000 feet. In its native state it is seen at its best growing along the edges of marshy valleys and in moist soil bordering springs and mountain streams. Under favorable conditions *Lilium pardalinum* increases from year to year, producing several new bulbs annually. Well-grown plants are quite as floriferous as the well-known St. Joseph's lily (*L. candidum*).

The flowers are arranged on long pedicels in an open raceme; the prevailing color is red or crimson, with the lower parts of the segments orange colored, and spotted with purple; the segments are much reflexed. There are, however, several varieties found in a wild state, varying from each other principally in the color of the flowers.

12681. CASTANEA VESCA. **Chestnut.**

From San Giovanni a Teduccio, near Naples, Italy. Received thru Damman & Co., January 7, 1905.

12682. GLADIOLUS hyb. **Gladiolus.**

From Chicago, Ill. Received thru Vaughan's Seed Store, January 7, 1905.

Princeps.

12683. NICOTIANA TABACUM. **Tobacco.**

From Wethersfield, Conn. Received thru Comstock, Ferre & Co., December 5, 1904.

Connecticut Seed Leaf.

12684 to 12692.

From Zaouia du Mornag, about 20 kilometers from Tunis, Tunis. Collected by Mr. T. H. Kearney, December 24, 1904, in the garden of M. Giraud, president of the Horticultural Society. Received January 9, 1905.

12684. OLEA EUROPAEA. **Olive.**

Bidh el Hammam. "The second largest olive of Tunis, and, according to Marzac, the best." (*Kearney.*)

12685. OLEA EUROPAEA. **Olive.**

Saiali Magloub. "One of the best of the medium-sized olives. According to Minangoin it is not a heavy yielder, but I did not get the impression that it is inferior in this respect to the large table olives. Probably Minangoin criticized it in this respect as an oil olive, but it is said to be excellent for the table." (*Kearney.*)

12686. CITRUS LIMONUM. **Lemon.**

Quatre Saisons. According to M. Giraud the best and the most widely grown lemon in Tunis; largely exported.

12687. CITRUS AURANTIUM. **Orange.**

Maltaise (No. 1). A smooth-skinned, deep-colored orange.

12688. CITRUS AURANTIUM. **Orange.**

Maltaise (No. 2). A smooth-skinned, large-leaved orange.

12684 to 12692—Continued.

12689. CITRUS AURANTIUM. **Orange.**

Maltaise (No. 3). Seedling.

12690. CITRUS AURANTIUM. **Orange.**

Blood, native variety.

12691. CITRUS BIGARADIA. **Bergamot orange.**

A smooth-skinned bigarade (bergamot?), said to be the best variety for making preserves.

12692. CITRUS AURANTIUM. **Orange.**

Trabelsi (Tripoli). The most abundant orange of Tunis.

12693. GARCINIA MORELLA. **Gamboge.**

From Kingston, Jamaica. Received thru Prof. William Fawcett, January 11, 1905.

"Seeds of the tree producing the true gamboge of commerce, which is procured principally from Siam and is used as a pigment for dyeing silks and other fabrics. The rind of the fruit is also used for tanning purposes. Introduced for the purpose of testing as a stock upon which to graft the mangosteen (*G. mangostana*). The gamboge has a hardier root system and is a very vigorous growing tree, and for this reason may prove of value as a stock." (*Fairchild.*)

12694 to 12696. MEDICAGO SATIVA. **Alfalfa.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., January 7, 1905.

12694. Grown in Provence.

12695. Grown in Poitou.

12696. Grown in Italy.

12697. ZEA MAYS. **Sweet corn.**

From Philadelphia, Pa. Received thru Henry F. Michell Company, January 11, 1905.

Sugar Loaf.

12698. PISUM SATIVUM. **Pea.**

From New York, N. Y. Received thru J. M. Thorburn & Co., January 12, 1905.

Thomas Laxton.

12699 to 12701.

From New York, N. Y. Received thru J. M. Thorburn & Co., January 13, 1905.

Drug and medicinal seeds ordered for the cooperative work conducted by the Office of Drug Plant Investigations.

12699. DIGITALIS PURPUREA.

12700. FOENICULUM DULCE.

12701. PIMPINELLA ANISUM.

12702. MEDICAGO SATIVA. **Alfalfa.**

From Sherman, Tex. Received thru Mrs. R. E. Smith, January 13, 1905.

12703. ALLIUM FISTULOSUM. **Welsh onion.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January 14, 1905.

Forcing. Grown from S. P. I. No. 9301.

12704 to 12707.

A collection of vegetable seeds for special tests.

12708. MUSA TEXTILIS. **Manila hemp.**

From Manila, P. I. Grown from seed received by Mr. G. W. Oliver, from Prof. W. S. Lyon, Insular Bureau of Agriculture, January 29, 1904.

12709. HORDEUM TETRASTICHUM. **Four-row barley.**

From Bozeman, Mont. Received thru Prof. F. B. Linfield, Agricultural Experiment Station, January 12, 1905.

Hull-less.

12710. CYPERUS PAPYRUS. **Papyrus.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., January 14, 1905.

12711 to 12715. ORYZA SATIVA. **Rice.**

From Yokohama, Japan. Presented by the Yokohama Nursery Company. Received January 12, 1905.

12711. *Banshiu honba.* Produce of Hiogo Ken.

12712. *Kairio.* From Shin-no-yen, Kasia Gun, Harima, 30 miles west of Kobe.

This "Kairio" seed quality is reported to be very strong against any diseases and endures injurious attacks. Produce of Hiogo Ken.

12713. *Futafushi wase.* Produce of Kanagawa Ken.

12714. *Makuno uchi.* Produce of Kanagawa Ken.

12715. *Kokeju.* Produce of Kanagawa Ken.

All of the above-named rices require only the ordinary rice cultivation practiced in Japan. They must have plenty of water from time of sowing till the ears are well formed.

12716. PSIDIUM MOLLE (?). **Guayabillo.**

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, January 14, 1905.

Packet of mixed seeds of strawberry and fig-flavored sorts collected at "La Trinidad," Guerrero, Mexico.

12717 to 12732.

A collection of vegetable seeds secured from various seedsmen for special testing purposes.

12733. BEGONIA sp. **Begonia.**

From Mount Vernon, N. Y. Received thru Mr. H. E. Le Page (representing Hubert & Co., Guernsey and Jersey, England), January 17, 1905.

Tuberous rooted.

12734. RHAMNUS PURSHIANA. **Cascara sagrada.**

From Olympia, Wash. Received thru Mr. A. W. McMurray, January 16, 1905.

Seedlings for cooperative work being conducted by the Office of Drug Plant Investigations.

12735. ATRIPLEX SEMIBACCATA (?). **Saltbush.**

From Tulare, Cal. Received thru Prof. A. V. Stubenrauch, January 17, 1905.

12736. PHASEOLUS VULGARIS. **Bean.**

From New York, N. Y. Received thru Peter Henderson & Co., January 16, 1905.

Bush Bountiful (green-podded).

12737. SECHIUM EDULE. **Chayote.**

From Dallas, Tex. Received thru Texas Seed and Floral Company, January 18, 1905.

12738. DAHLIA MERCKII. **Dahlia.**

From Edinburgh, Scotland. Received thru Prof. Bayley Balfour, regius keeper, Royal Botanic Garden, January 18, 1905.

This species is hardy at Edinburgh.

12739 to 12742. SACCHARUM OFFICINARUM. **Sugar cane.**

From Kingston, Jamaica. Received thru Mr. William Fawcett, director of Hope Gardens, January 16, 1905.

12739. *Bourbon.*

12740. *B. 306.*

12741. *D. 99.*

12742. *D. 115.*

12743. PHASEOLUS VULGARIS. **Bean.**

From Columbus, Ohio. Received thru the Livingston Seed Company, January 18, 1905.

Kenney's Rustless Golden Wax.

12744. BETA VULGARIS. **Sugar beet.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January 19, 1905.

"Grown on C. C. Morse & Co.'s farm at Gilroy, Cal., for the general trade. Not the product of chemically analyzed roots, but rather from roots selected according to shape, size, etc., judged by their external appearance." (*J. E. W. Tracy.*)

12745. BETA VULGARIS. **Sugar beet.**

From Fairfield, Wash. Received thru Mr. E. H. Morrison, January, 1905. Crop of 1904.

"Grown on E. H. Morrison's farm at Fairfield, Wash., for the general trade, from roots selected according to shape, size, etc., judged for their external appearance only." (*J. E. W. Tracy.*)

12746. PISTACIA VERA. **Pistache.**

From Tashkend, Russian Central Asia. Received thru Mr. H. W. Dürrschmidt, January 20, 1905.

12747. MEDICAGO SATIVA. **Alfalfa.**

From Billings, Mont. Received thru Mr. I. D. O'Donnell, January 19, 1905.

12748. MEDICAGO SATIVA. **Alfalfa.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., January 20, 1905.

Seed grown in the state of Hesse, Germany, and is known as *Eifeler Luzerne* in the Rhine Province.

12749 and 12750. CUCURBITA sp. **Squash.**

From Garrett Park, Md. Received thru Mr. D. S. Bliss, January 21, 1905. Grown from S. P. I. No. 9481 during the season of 1904.

12749. Large cylindrical sort.

12750. Crook-neck.

"The seeds of the large sort are from the first fruit that formed before any blossoms showed on any other vines, and, so far as I know, there were no other vines nearer than half a mile. The seeds of the smaller fruits are from a dozen mixed." (*Bliss.*)

12751. (Undetermined.)

From Barberton, Africa. Received thru Hon. W. Stanley Hollis, United States consul at Lourenço Marquez, Africa, January 14, 1905.

"A very fine, edible 'plum,' which grows in the mountains near Barberton on trees about 6 feet high." (*Hollis.*)

12752. DOLICHOS UNIFLORUS. **"Kulthi."**

From Quard Hitlow Koppa, Mysore Province, India. Received thru Mr. W. Maxwell Maynard, January 20, 1905.

"According to Mr. Maynard this legume is grown extensively in India and fed to horses and working bullocks and is also considered valuable for using in the coffee estates. Sent by Mr. Maynard to Dr. George T. Moore for the purpose of interesting him in the cultivation of the micro-organism which forms the nodules on this as well as other leguminous plants." (*Fairchild.*)

12753 and 12754. OLEA EUROPAEA. **Olive.**

From Sousse, Tunis. Collected by Mr. T. H. Kearney. Received January 21, 1905.

12753. *Barouni.*
12754. *Yacouti.*

12755. CORNUS KOUSA.

From New York, N. Y. Received thru Henry & Lee, 97 Water street, January 23, 1905.

12756. BRASSICA NIGRA. **Black mustard.**

From Philadelphia, Pa. Received thru W. A. Burpee & Co., January 24, 1905.

Fordhook Fancy.

12757. BAMBUSA STRIATA. **Bamboo.**

From Niles, Cal. Received thru the California Nursery Company, January 25, 1905.

12758. CYPHOMANDRA BETACEA. **Tree tomato.**

From Kingston, Jamaica. Received thru Mr. G. N. Collins, January, 1905.

"This is a species of South American shrub from the mountainous regions of Brazil, adjacent to Peru. Cultivated occasionally for the egg-shaped, reddish-brown, faintly striped fruits. Fruits about 2 inches long on slender stalks, 2 celled, seedy, musky acid and tomato-like in flavor; agreeable to those who like tomatoes." (*Bailey.*)

Bears the second or third year from seed under glass. This tomato has been successfully introduced into Jamaica, Ceylon, and other mountainous regions of the Tropics, and in many places is considered a valuable addition to the list of garden vegetables. It would, in all probability, thrive in Porto Rico. (*Cook and Collins, Contr. Nat. Herb.*, VIII, p. 132.)

"Succeeds best with a mean annual temperature of 68° F. Can be propagated readily from seed in warm countries." (*Bailey's Forcing Book.*)

12759 and 12760. ORYZA SATIVA. **Rice.**

From Buitenzorg, Java. Received thru Doctor Treub, of the Botanical Gardens, December 5, 1904.

12579. *Tjiomas.*
12760. *Carolina.*

12761 to 12765. ORYZA SATIVA. **Rice.**

From Yokohama, Japan. Presented by the Yokohama Nursery Company. Received December 12, 1904.

Unhulled rice as follows:

12761. *Bankoku ichi.*
12762. *Jugoya.*
12763. *Makuno uchi.*
12764. *Sekitori.*
12765. *Ko-zo.*

12766 to 12768.

From Wonsan, Korea. Received thru Mr. C. F. S. Bilbrough, Chosen Holme, January 21, 1905.

12766. Oryza sativa. **Rice.**

With a light husk.

12767. Oryza sativa. **Rice.**

With dark-brown husk.

12768. Clerodendron sp.

12769. Delphinium sp. **Larkspur.**

From Holland, Mich. Received thru Mrs. H. Kremers, January 25, 1905.

12770. Cucumis melo. **Muskmelon.**

From Augusta, Ga. Received thru Alexander Seed Company, January 21, 1905.

Nixon.

12771. Citrullus vulgaris. **Watermelon.**

From Philadelphia, Pa. Received thru Mr. William Henry Maule, January 21, 1905.

Harris's Earliest.

12772. Medicago sativa. **Alfalfa.**

From Dell, Oreg. Received thru Mr. M. D. Kelley, January 26, 1905.

Grown from S. P. I. No. 9450.

12773. Castanea crenata. **Japanese chestnut.**

From New York City. Presented by Mr. F. W. Bruggerhof, president of the J. M. Thorburn Company, 36 Cortlandt street. Received January 25, 1904.

12774. Linum usitatissimum. **Flax.**

From Pskoff, Russia. Received thru Malcolm & Co., January 21, 1905.

12775. Phaseolus radiatus. **Mung bean.**

From Calhoun, S. C. Received thru Mr. C. C. Newman, January 27, 1905.

Newman.

12776. Dodecatheon meadia. **Shooting-star.**

From Takoma Park, D. C. Received thru Mr. A. J. Pieters in the autumn of 1904.

12777 to 12779.

From Murtee Station, Wilcannia, New South Wales, Australia. Presented by Mr. E. W. Davis. Received January 28, 1905.

Seeds of native plants.

12777. Atriplex nummularia. **Old-man saltbush.**

12778. Atriplex holocarpa. **Annual saltbush.**

12779. Tetragonia expansa. **New Zealand spinach.**

12780 and 12781.

From Cape Town, South Africa. Presented by Prof. J. Burtt Davy, government agrostologist and botanist. Received January, 1905.

12780 and 12781—Continued.

12780. Ficus sp.

"From southern Rhodesia. Well worth cultivating; very large tree; suitable for southern California, Florida, and Louisiana." (*Davy.*)

12781. Acacia sp.

"From southern Rhodesia. Well worth cultivation in southern California and southern Florida." (*Davy.*)

12782 and 12783. Pistacia vera. **Pistache.**

From Bronte, Sicily. Collected by Mr. Thomas H. Kearney. Received January 30, 1905.

12782. Staminate cuttings. **12783.** Carpellate cuttings.

12784. Medicago sativa. **Alfalfa.**

From Ogden, Utah. Received thru the C. A. Smurthwaite Produce Company, January 30 and March 9, 1905.

This seed was raised in Emery County, Utah, on land that is irrigated. The land has been cropt for forage for fifteen years, and in 1904 it was cropt for seed for the first time. This seed was taken from second growth.

12785. Papaver rhoeas. **Shirley poppy.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January 30, 1905.

Santa Rosa, a new variety originated by C. C. Morse & Co.

12786 to 12789. Saccharum officinarum. **Sugar cane.**

From Trinidad, British West Indies. Received thru Mr. J. H. Hart, superintendent of the Botanical Gardens, January 29, 1905.

12786. *T. 105.* **12788.** *T. 223.*

12787. *T. 215.* **12789.** *T. 230.*

12790 to 12800.

From New South Wales, Australia. Received thru Mr. H. W. Potts, principal of the Hawkesbury Agricultural College, February 1, 1905.

A collection of seeds as follows:

12790. Acacia baileyana. **Cootamundra wattle.**

12791. Acacia elongata. **"Sally" wattle.**

Tall shrub or small tree.

12792. Acacia linearis. **Wattle.**

12793. Acacia lunata. **"Golden Glory" wattle.**

A handsome shrub with dense masses of golden-yellow flowers rising 4 to 5 feet.

12794. Acacia trinervata. **Mountain wattle.**

12795. Bossiaea rhombifolia.

A native, rigid, small shrub, the pods characteristically attacked by an Aecidium.

12796. Casuarina suberosa.

A tree pinelike in appearance, with leafless, jointed branches.

12797. Dodonaea viscosa.

A shrub rising to from 4 to 6 feet.

12790 to 12800—Continued

12798. ELAEOCARPUS CYANEUS.

A small tree.

12799. ERAGROSTIS PILOSA. **Weeping love grass.**

12800. KENNEDYA RUBICUNDA

A scarlet-flowered creeper.

12801. MEDICAGO SATIVA. **Alfalfa.**

From Mulock, Tex. Received thru Mr. J. M. Simmons, February 1, 1905.

12802. ALNUS MARITIMA JAPONICA. **Alder.**

From New York, N. Y. Received thru Suzuki & Iida, February 2, 1905.

"A deciduous tree growing in wet places, attaining a height of 20 to 30 feet. In spring it produces male and female flowers separately before it sprouts. The male flowers hang down from the branches in the form of a catkin, and the female flowers yield round fruits with scales. In the autumn when the fruits fully ripen, being about 1 inch in length, they are collected and dried for dyeing." (*Useful Plants of Japan.*)

"This plant is considered essential in the cultivation of the Japanese paper plant, mitsumata. It is used as a 'shelter' plant and is invariably planted on the plantation of the paper plant. It is doubtful if the effect accredited to this plant, viz, shade and shelter, is the real reason for its culture.

"It has been suggested by Mr. W. T. Swingle that since the genus Alnus has a root system bearing root nodules which store up nitrogen that this plant enriches the soil in which the paper plants are grown. This plant should be carefully studied relative to this particular point." (*Fairchild.*)

12803. MEDICAGO SATIVA. **Alfalfa.**

From Setif, Algeria. Received thru Mr. G. Ryf, Setif, February 2, 1905.

Getula. "This variety of alfalfa is said by Mr. Ryf, who has devised a most ingenious method of cultivating alfalfa and wheat on the same land at the same time, to be more drought resistant than the ordinary French lucern, and it is believed that this variety may prove of special value in experiments in the arid regions of our Southwest." (*Fairchild.*)

12804. JUNCUS EFFUSUS (?). **Matting rush.**

From Chico, Cal. Received thru Mr. P. H. Dorsett, Plant Introduction Garden, February 13 and 20, 1905.

"Plants of the California rush for experiments in the culture of the matting rush." (*Fairchild.*)

12805. HUMULUS LUPULUS. **Hop.**

From Nuremberg, Germany. Received thru S. B. Bing Sons, hop merchants, September 30, 1904.

Saaz City.

12806. HUMULUS LUPULUS. **Hop.**

From Puyallup, Wash. Received thru Mr. W. H. Lawrence, assistant at the Agricultural Experiment Station, November 14, 1904.

12807. HUMULUS LUPULUS. **Hop.**

From Germany. Received November, 1904.

12808. ORYZA SATIVA. **Rice.**

From Colombo, Ceylon. Presented by Dr. C. Drieberg, superintendent of School Gardens. Received January 28, 1905.

Grown in the Hambantote district.

12809. ANACARDIUM QCCIDENTALE. **Cashew nut.**

From Salisbury, Rhodesia, South Africa. Received thru Mr. George M. Odlum, Department of Agriculture, February 3, 1905.

From wild trees in Portuguese East Africa that seem to bear more freely than those cultivated in the West Indies and may prove hardier.

12810 and 12811.

From Portuguese East Africa. Presented by Hon. Stanley Hollis, United States consul, Lourenço Marquez, thru the Assistant Secretary of State. Received January 28, 1905.

12810. (Undetermined.) **Matundulaku.**

Fruits of a sour "plum" sent to Mr. Hollis by Mr. A. E. Graham-Lawrence, of Barberton.

12811. GARCINIA LIVINGSTONEI. **Pimbe.**

A Lourenço Marquez wild "plum."

12812. (Undetermined.)

From Hankow, China. Presented by Dr. L. S. Wilcox, United States consul-general. Received January 31, 1905.

12813. BRASSICA OLERACEA. **Cabbage.**

From Norton, N. C. Received thru Mr. B. Norton, February 2, 1905.

North Carolina Buncombe.

12814. ARACHIS HYPOGAEA. **Peanut.**

From Marseille, France. Received thru Hon. Robert P. Skinner, United States consul-general, February 3, 1905.

"A sample of 'Arachides' from the province of Sine in Senegal. These are the very best nuts known in this market for the manufacture of oil." (*Skinner.*)

12815. PISTACIA VERA. **Pistache.**

From near Caltanisetta, Sicily. Received thru Mr. T. H. Kearney, February 4, 1905.

Trabonella.

12816. MEDICAGO SATIVA. **Alfalfa.**

From Chinook, Mont. Received thru the Thomas O'Hanlon Company, February 6, 1905.

Grown by Mr. F. T. Reser, 1 mile west of Chinook.

12817. PHASEOLUS VULGARIS. **Bean.**

From Leroy, N. Y. Received thru Mr. A. N. Jones, February 25, 1905.

Golden Crown Wax.

12818. PHASEOLUS VULGARIS. **Bean.**

From Chaumont, N. Y. Received thru Roger Brothers, February 25, 1905.

Golden Carmine-Podded Horticultural.

12819. Lippia repens.

From Santa Barbara, Cal. Received thru Dr. F. Franceschi, February 10, 1905.

12820. Medicago sativa. **Alfalfa.**

From Clearwater, Nebr. Received thru Mr. G. E. Miller, February 7, 1905.

12821. Psidium molle. **"Guayabillo."**

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, February 4, 1905.

12822 to 12831. Amygdalus communis. **Almond.**

From Girgenti, Sicily. Received thru Mr. T. H. Kearney, February 6, 1905.

Varieties of almond cuttings selected by Mr. Casá from his collection of 25 varieties.

12822. Sweet; big fruit.

12823. Sweet; long fruit.

12824. Sweet; fruit dark red.

12825. Sweet; fruit double.

12826. Bitter.

12827. Sweet, with "a point at one side" (end).

12828. Tender, sweet; good for table.

12829. Early flowering, sweet, hard-shelled.

12830. Not frost resistant.

12831. Late flowering; resistant to frost.

12832 to 12842.

From Catania, Sicily. Received thru Mr. T. H. Kearney, February 8, 1905.

12832 to 12835.

Received from Salvatore Leanza, nurseryman, Catania, Sicily.

12832. Eriobotrya japonica. **Loquat.**

"A valuable and distinct, semiseedless grafted variety, which may be especially recommended. Fruit especially large, pear-shaped, with a fleshy, juicy, sugary pulp; with a few small seeds, which are in some cases extremely small according to the modification produced by their surroundings, whether in pots or in open ground with a ball of earth." (*Kearney.*)

12833 and 12834. Corylus avellana. **Filbert.**

Castiglione.

12835. Pistacia vera. **Pistache.**

Bronte.

12836 to 12842. Opuntia spp. **Prickly pear.**

Presented by Doctor Cavara, of the Catania Botanical Gardens, Sicily.

12836. Opuntia tomentosa.

A variety of opuntia that holds its fruit all winter. (Doctor Cavara's No. 5.)

12837. Opuntia ficus indica.

"Fructu albo, vulgo 'Zuccherina.'" (Doctor Cavara's No. 2.)

12838. Opuntia ficus indica.

"Fructu albo, vulgo 'Sipala.'" (Doctor Cavara's No. 1.)

12839. Opuntia ficus indica.

"Fructu flavo, vulgo 'Figu d'India.'" (Doctor Cavara's No. 4.)

12840. Opuntia ficus indica.

"Fructu rubro, vulgo 'Sanguigua.'" (Doctor Cavara's No. 3.)

12832 to 12842—Continued.

12836 to 12842—Continued.

12841. OPUNTIA FICUS INDICA.

"Fructu flavo-carne, compacta, vulgo 'Brontese.'" (Doctor Cavara's No. 7.)

12842. OPUNTIA FICUS INDICA.

"Fructu albo-venosa." (Doctor Cavara's No. 6.)

12843 to 12845. CUCURBITA sp. **Squash.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company, February 7, 1905.

12843. *Kikugata* (early).

12844. *Chilimen* (early).

12845. *Kikuza* (late).

12846 to 12848.

From Tunis. Received thru Mr. T. H. Kearney, December 28, 1904.

12846. MEDICAGO SATIVA. **Alfalfa.**

Oasis. From Kebili.

12847. MEDICAGO SATIVA. **Alfalfa.**

Tripoli. From Gabes.

12848. PISTACIA VERA. **Pistache.**

From Sfax. Nuts from the 1904 crop.

12849. CANNABIS SATIVA. **Hemp.**

From Nicholasville, Ky. Received thru W. L. Steel & Co., February, 1904.

12850. FEIJOA SELLOWIANA.

From Sao Paulo, Brazil. Presented by Mr. Alberto Löfgren, Botanic Gardens. Received March 11, 1905.

"A plant belonging to the guava family. Plants of this new fruit have been grown by Mr. Taft and Doctor Franceschi in southern California, and small immature fruits have been borne by single plants grown by these parties. The plant has been successfully cultivated on the Riviera, where there are several specimens of considerable size which have borne excellent fruit. Doctor André, who has paid special attention to this fruit, pronounces it, in flavor, something exceptionally delicious. The fruits are about the size of a large English walnut, green in color and covered with blunt protuberances. Little is known at the present time in this country regarding the actual flavor of the fruit. The fruit is of a character which enables it to be plucked from the bush before ripening. It is believed that this plant can be grown successfully in all the frostless regions of the Southwest. It is well worthy of serious consideration by all those interested especially in subtropical fruit culture." (*Fairchild.*)

12851. PENNISETUM TYPHOIDEUM. **Pearl or cat-tail millet.**

From Augusta, Ga. Received thru the N. L. Willet Drug Company, March 13, 1905.

12852. ORYZA SATIVA. **Rice.**

From Augusta, Ga. Received thru the N. L. Willet Drug Company, March 13, 1905.

12853. TRITICUM DICOCCUM. **Emmer.**

From Lawrence, Kans. Received thru F. Barteldes & Co., February 22, 1905.

12854. HORDEUM VULGARE. **Barley.**

From Geneva, Idaho. Received thru Mr. F. W. Boehme, March 15, 1905.

12855. SECALE CEREALE. **Rye.**

From Geneva, Idaho. Received thru Mr. F. W. Boehme, March 15, 1905.

12856 to 12861.

From Vomero, Naples. Presented by Dr. Carl Sprenger thru Mr. E. A. Bessey. Received January, 1905.

12856. RICINUS ZANZIBARIENSIS. **Castor-oil plant.**

Package of mixed varieties.

12857. SESBANIA TRIPETII. **Red acacia.**

"One of the finest flowering shrubs."

12858. RHAMNUS ALATERNUS CALABRICA.

12859. MORUS ALBA. **White mulberry.**

China.

12860. SIDERITIS MASSONIANA. **12861.** PICRASMA AILANTHOIDES.

12862 to 12864.

From Paris, France. Received thru Vilmorin-Andrieux & Co., February 10, 1905.

12862. CYNARA SCOLYMUS. **Artichoke.**

Large flat *Brittany.*

12863. CUCUMIS SATIVUS. **Cucumber.**

12864. SANVITALIA PROCUMBENS FLORE PLENO.

12865 to 12871. ORYZA SATIVA. **Rice.**

From Calcutta, India. Presented by I. H. Burkill, esq., M. A., officiating reporter on economic products to the government of India, Indian Museum, 1 Sudder street. Received February 9, 1905.

12865. *Masina ghaiya.* From Bengal Province.

12866. *Bhadai ghaiya*, red. From Bengal Province.

12867. *Thosar Bhadai ghaiya*, white. From Bengal Province.

12868. *Pakhasali Bhadai.* From Bengal Province.

12869. *Augua Bhadai.* From Bengal Province.

12870. Small red variety. From Bengal Province.

12871. *Takmaroo ghaiya.* From Bengal Province.

This paddy was grown by the Lepchas and Bhootias.

12872. CHRYSANTHEMUM ANETHIFOLIUM. **Chrysanthemum.**

From Merrifield, N. Dak. Presented by Mrs. H. E. Bancroft. Received February, 1905.

Mrs. Bancroft writes that this is a perennial there, but blossoms early the first year from seed. The largest blossoms are the early ones, being three times as large as those sent, which were gathered on November 13, 1904.

12873. ESCHSCHOLTZIA CALIFORNICA. **California poppy.**

From Merrifield, N. Dak. Presented by Mrs. H. E. Bancroft. Received February, 1905.

Mrs Bancroft writes that by constant selection she has developed a strain of California poppy with flowers much larger than the ordinary, which continue in bloom much later than the common kind.

12874 to 12876. ORYZA SATIVA. **Rice.**

From Canton, China. Presented by Mr. T. E. Griffith. Received January 28, 1905.

Samples of Chinese rice, as follows:

12874. "*Shie-Miu.*" (No. 1.)

12875. "*Ai-Miu.*" (No. 2.)

12876. "*Laer-Chap.*" (No. 3.)

"As to the local manner of planting this rice, a seed bed some 30 yards square is prepared alongside of the large rice fields about the month of August. This seed bed is composed of softish mud, and the grain is scattered over the surface, which is kept wet enough to cause it to sprout. In about three weeks' time the mass of seedlings are about 10 inches in height, when they are taken up and planted out in the rice fields in bunches of 20 or so seedlings together, at intervals of a foot between bunches.

"The soil of the fields is a bluish alluvial mud, and, after planting, it is kept constantly inundated with water from the numerous creeks which intersect the country. In about one hundred days from planting out the grain is ripe, and is then gathered in." (*Griffith.*)

12877 to 12895.

From New Zealand. Presented by the government of New Zealand thru Mr. M. A. Carleton. Received February 11, 1905.

A collection of grains, etc., from the New Zealand exhibit at the Lousiana Purchase Exposition, St. Louis, Mo., 1904.

12877 to 12882. AVENA SATIVA. **Oat.**

12877. *Danish.*

12878. *Dun.*

12879. *Sparrowbill.*

12880. *Canadian.*

12881. *White Tartar.*

12882. *Black Tartar.*

12883 to 12886. TRITICUM VULGARE. **Wheat.**

12883. *Pearl.*

12884. (No label.)

12885. *Hunter's.*

12886. *Tuscan.*

12887 to 12889. PISUM SATIVUM. **Pea.**

12887. *Brown.* (Marked "B.")

12888. *Green.* (Marked "C.")

12889. *Green.*

12890. TRIFOLIUM REPENS. **White clover.**

12891. TRIFOLIUM PRATENSE. **Red clover.**

Colonial.

12892. LOLIUM ITALICUM. **Italian rye-grass.**

12893. LOLIUM PERENNE. **Perennial rye-grass.**

12894. PHLEUM PRATENSE. **Timothy.**

Colonial.

12895. DACTYLIS GLOMERATA. **Orchard grass.**

12896. LILIUM NEILGHERRENSE. **Neilgherry lily.**

From Utakamund, India. Received thru Mr. G. H. Cave, superintendent of the Government Botanic Gardens, February 14, 1904.

12897 to 12899.

From Durban, Natal. Presented by Mr. J. Medley Wood, director of the Botanic Gardens. Received February 14, 1905.

12897. COFFEA ZANGUEBARIAE (?). **Coffee.**

"According to a letter of January 12, 1905, from Mr. Wood, this species of Coffea, regarding the identification of which he is doubtful, is quite immune

12897 to 12899—Continued.

to attacks of the *Hemileia vastatrix.* It is grown in the Botanic Gardens within a few feet of Coffea plants covered with this fungus, and Mr. Wood has endeavored to inoculate the plant with it but has been unsuccessful. He further states that it is a handsome shrub, in addition to its value for hybridizing purposes for *Coffea arabica* or other species.' His idea is, further, that it might be used as a stock upon which to graft the Arabian Coffea." (*Fairchild.*)

12898. ASPARAGUS VIRGATUS.

"According to Mr. Wood this species is cultivated in Natal and is considered to have a distinct flavor of its own and to be a desirable vegetable. This same species has been in cultivation in America for some time as an ornamental." (*Fairchild.*)

12899. PASSIFLORA EDULIS.

"In Natal one of the commonest fruits on the market is this passion fruit. Its cultivation requires very little attention and it seems to be a very productive vine. This could be cultivated to advantage in the frostless regions of California and Florida, and attempts should be made to cross it with the Maypop, which is a common species of Passiflora growing in the Carolinas In New Zealand and Australia the fruit has become a popular one on the market." (*Fairchild.*)

12900 to 12908.

From Washington, D. C. Grown on the Potomac Flats under the direction of Dr. R. H. True, Physiologist in Charge of Drug and Medicinal Plant Investigations. Received February 5, 1905.

A collection of drug and medicinal plant seeds, as follows:

12900. ATROPA BELLADONNA. **Belladonna.**

12901. CARUM CARVI. **Caraway.**

12902. CONIUM MACULATUM. **Poison hemlock.**

12903. CORIANDRUM SATIVUM. **Coriander.**

12904. LOBELIA INFLATA. **Lobelia.**

12905. SATUREJA HORTENSIS. **Summer savory.**

12906. PAPAVER SOMNIFERUM. **Poppy.**

A white-seeded opium poppy.

12907. PAPAVER SOMNIFERUM. **Poppy.**

A blue-seeded opium poppy.

12908. CHENOPODIUM ANTHELMINTICUM. **American wormseed.**

12909. SECHIUM EDULE. Chayote.

From New Orleans, La. Received thru the J. Steckler Seed Company, February 11, 1905.

12910. OLEA EUROPEA. Olive.

From Tunis, North Africa. Received thru Mr. T. H. Kearney, February 13, 1905.

Chitoni. "This is the principal and best oil variety of northern Tunis, but is said not to do so well in drier and hotter parts." (*Kearney.*)

12911 to 12917.

From Brookings, S. Dak. Received thru Prof. N. E. Hansen, Agricultural Experiment Station, January 18, 1905.

A collection of ornamentals, as follows:

12911. (Undetermined.) **"Siberian sand thorn."**

12911 to 12917—Continued.

12912. CARAGANA MICROPHYLLA.

12913. CARAGANA ARBORESCENS. **Siberian pea tree.**

12914. SALIX sp. **Niobe weeping willow.**

12915. ROSA RUGOSA. **Pasture rose.**

12916. SALIX sp. **Ural willow.**

12917. SALIX VIMINALIS REGALIS.

12918. BETA VULGARIS. **Sugar beet.**

From Fort Collins, Colo. Received thru the Colorado Experiment Station, February 14, 1905.

Kleinwanzleben.

12919. RAPHANUS SATIVUS. **Radish.**

From Fairfield, Wash. Received thru Mr. E. H. Morrison, February 13, 1905.

Crimson Giant Forcing. Grown from S. P. I. No. 9487.

12920. NICOTIANA TABACUM. **Tobacco.**

From Washingtonboro, Lancaster County, Pa. Received thru Mr. Frank C. Wittmer, February 14, 1905.

12921 to 12926.

From Sfax, Tunis, North Africa. Received thru Mr. T. H. Kearney, February 17, 1905.

12921. OLEA EUROPAEA. **Olive.**

"The *Chemlali* variety, being probably the best adapted of all olives to a dry, hot climate, will be useful as a stock even if it does not succeed with us as an oil variety." (*Kearney.*)

12922. PISTACIA VERA. **Pistache.**

White-skinned variety.

12923. PISTACIA VERA. **Pistache.**

Red-skinned variety.

12924. PISTACIA VERA. **Pistache.**

Male.

"Through the kindness of Mr. Leonardi, British vice-consul, I was able to visit a garden here (Sfax) belonging to two Italian Jews, where there are 16 pistache trees (one male). The gardeners told me there are three kinds of pistaches here, all with green kernels, but one having a white, one a red, and one a red-and-white streaked skin. The first is considered the best, and from a tree of this kind, said to bear very heavily, was taken most of the grafting wood (12922). Grafting can be done successfully here up to the end of February." (*Kearney.*)

12925. PUNICA GRANATUM. **Pomegranate.**

"Pomegranate cuttings taken from a single bush, said to be a very fine, large, red-fruited one. Here it is propagated by cutting off the vigorous root shoots where they are about a half inch thick and sticking them into the ground so that the main stem is horizontal and is covered with earth, while the stiff, divergent branches stick up vertically. In this way a good-sized bush, bearing well, is obtained in two years." (*Kearney.*)

12926. (Undetermined.)

12927 to 12929. Trifolium sp. Clover.

From Corfu, Greece. Received thru Mr. C. S. Scofield in 1901. Seeds gathered on the place of Mr. Antonio Colla.

12927. Trifolium maritimum.

12928. Trifolium polystachyum.

12929. Trifolium procumbens.

12930 and 12931. Mangifera indica. Mango.

From Honolulu, Hawaii. Presented by Mr. G. P. Wilder. Received February 20 and 21, 1905.

12930. *Russet.*

12931. (Not named.)

12932. Carum gairdneri (?).

From Winslow, Wash. Received thru Mr. John L. Hubbard, March 6, 1905.

"This plant grows thruout eastern Washington, Oregon, and Idaho, and is called by the Indians on the Umatilla Reservation, in eastern Oregon, *Sow-itk.* This plant is similar in foliage to the carrot, is a hardy perennial with a root similar to the sweet potato, and is very pleasant to the taste, either raw or cooked. When it is raw the meat is about the consistency of a raw potato, of a sweet taste; when cooked it becomes mealy, like a baked sweet potato. It was used extensively as a food staple by the Indians thruout the Northwest before the advent of the white people, and is used by them to some extent yet.

"That the plant is susceptible of material development is proven by its being found to grow much larger in plowed fields or cultivated soil, where the roots have not been destroyed by such cultivation. I believe that if your Department would give this matter your attention a new and valuable vegetable would be added to the food products of the country." (*Letter dated January 30, 1905, from Mr. Hubbard.*)

Mr. F. V. Coville, botanist, in a letter dated March 16, 1905, gives the following information: "The plant is widely used for food among the northwestern Indians. The late Major Bendire, of the United States Army, considered it one of the most delicious vegetables he had ever tasted. I shall be very glad, indeed, to see Mr. Oliver take up its culture with a view to its domestication. It would be a vegetable somewhat of the type of the sweet potato. You will be interested to know that, by reason of the summer drought prevalent in the regions where the plant grows, the growing period of the species is short, a fact which will be very advantageous in connection with its proposed domestication."

12933 to 12937. Persea gratissima. Avocado.

From Miami, Fla. Propagated by Prof. P. H. Rolfs, pathologist in charge of Subtropical Laboratory. Numbered February 21, 1905.

12933.

Baldwin. "Tree a vigorous grower, with strong central stem; branches rather rigid; light bloomer, but heavy cropper. Blooms in February and March. Fruit at best in August; drops in September. Ripens uniformly. Shape of fruit approaching oblong, 4 by 5½ inches, not regular; color green, with a few yellowish streaks; rind smooth, thin; stem small; meat deep cream, one-fourth green, firm; flavor excellent. Seeds are rather large, firm in cavity. Buds do not take readily. Named for Mr. Baldwin, of Miami, Fla., who owns the original tree." (*Rolfs.*)

12934.

Chappelow. "Tree grows vigorously; branches diffuse, slender, inclined to droop; bark of young branches shiny, greenish yellow. Good cropper and abundant bloomer. Blooms in January and February; fruit ripens in June and July.

"Shape of fruit, bottle-necked, 2½ by 4½ inches; color dull purple; skin thin, leathery; meat greenish near rind, whitish toward seed; seed medium; firm in cavity; edible qualities good, but different from other type. The buds take readily and the tree stands more cold than other varieties planted. Most useful for home consumption. Named for Mr. William Chappelow, Monrovia, Cal. Buds secured thru Mr. William A. Taylor." (*Rolfs.*)

12933 to 12937—Continued.

12935.

Family. "A strong growing tree of spreading habits, being an abundant bloomer and moderate cropper. Blooms in late February and during March. Ripens fruit during July, August, September, and into October.

"Shape of fruit variable, from pear-shaped to long oblong, nearly banana-shaped; size, variable from 6 by 3½ to 3½ by 1½ inches; color purple, with scarlet streaks, very attractive; skin medium thick, smooth; stem large; meat yellow, free from fiber; flavor good, seed small, loose in cavity.

"The principal merit of this variety lies in extending its period of ripening over so long a time, being distinctly useful for family purposes, but should not be planted for commercial purposes, as the extended ripening period necessitates several pickings. Buds take readily." (*Rolfs.*)

12936.

Pollock. "Tree moderate grower, heavy bearer, profuse bloom, limbs rigid; blooms in February and March; ripens in September and October. Upright grower with strong central stem.

"Fruit pear-shaped, being about 6½ by 4½ inches; weight up to 3½ pounds; color greenish; rind medium; meat yellowish; flavor good; seed medium. Buds take readily, and this variety is desirable on account of very large fruits. Named for Mr. Pollock, of Miami, Fla., who owns the original tree." (*Rolfs.*)

12937.

Trapp. "Tree upright grower with strong central stem; not a vigorous grower. Produces abundant bloom late in February and March. A heavy cropper, maturing in October and November, some of the fruits remaining on the trees until the Christmas holidays.

"Shape of fruit rather between round and oblong, about 4½ by 3½ inches, regular; color greenish with yellowish streaks; thin rind; small stem; meat rather deep yellow; seed variable, sometimes very large and firm in cavity, and again very small and loose in cavity.

"The special merit of this variety lies in the fact that the fruit remains on the tree until late in the season. Named for Mrs. Trapp, Cocoanut Grove, Fla., who owns the original tree." (*Rolfs.*)

12938. GOSSYPIUM sp. **Cotton.**

From Peru, South America. Received thru W. R. Grace & Co., 1 and 2 Hanover square, New York, N. Y., February 13, 1905.

"Full rough" *Catacaos* seed. Represents the seed of the full rough Peruvian cotton, which is grown in the Piura and the surrounding districts in the northern part of Peru.

This "Full rough" cotton is exported to New York and Liverpool markets. There are two crops every year: "San Juan" and "Navidad." The former is largest and is gathered in August to September, while the latter is ready for shipment from the end of January thru April. We would say that the average annual crop was 18,000 bales of 200 pounds.

Many experiments have been made to plant this seed and grow the same grade of cotton in other localities but without success, because soil similar to that of the Piura districts (where it seldom rains) is yet to be found. Every attempt to transplant this grade to any other place in Peru was either a complete failure or the cotton degenerated into "Moderate rough."

12939. ZEA MAYS. **Corn.**

From Montgomery, Ala. Received thru Charles & Nelson, No. 8 Commerce street, February 11, 1905.

Mexican June.

12940 to 12957. VITIS spp. **Grape.**

From Thomery, France. Received thru Etienne Salomon & Sons, February 24, 1905.

12940. *Alicante Bouschet × Riparia 141-A.*

12941. *Berlandieri × Riparia 157-11.*

12940 to 12957—Continued.

12942. *Berlandieri × Riparia 420–B.*

12943. *Berlandieri Lafont No. 9.*

12944. *Bourisquou × Rupestris 3907.*

12945. *Carignane × Rupestris 503.*

12946. *Riparia × Rupestris-Aramon-Jaeger 201.*

12947. *Riparia Ramon.*

12948. *Rupestris Mission.*

12949. *Riparia Grand Glabre × Aramon-Rupestris 4110.*

12950. *Riparia × Cordifolia-Rupestris 106–8.*

12951. *Rupestris × Berlandieri 301–37–152.*

12952. *Riparia Colorado.*

12953. *Solonis × Riparia 1615.*

12954. *Vialla.*

12955. *Aramon × Riparia 143–A.*

12956. *Cinerea-Rupestris × Riparia 239.*

12957. *Riparia × Rupestris 108–103.*

12958. Ipomoea sp.

From Cuba. Received thru Prof. P. H. Rolfs, Subtropical Laboratory, Miami, Fla., February 23, 1905.

Seeds of a variety of Ipomœa that is found in Cuba. Said to have yellow flowers.

12959. (Undetermined.) **Matundulaku.**

From Eureka City, Transvaal. Presented by A. T. Metcalf, esq., thru Hon. W. Stanley Hollis, United States consul, Lourenço Marquez, Portuguese East Africa. Received February 23, 1905.

"Evidently a plum-like fruit with a very large stone and little meat." (*Fairchild.*)

12960. Garcinia livingstonei. **Pimbe.**

From Lourenço Marquez, Portuguese East Africa. Presented by Hon. W. Stanley Hollis, United States consul. Received February 23, 1905.

12961. Hydrangea scandens.

From Philadelphia, Pa. Received thru Thomas Meehan & Sons, February 23, 1905.

12962. (Undetermined.)

From Lourenço Marquez, Portuguese East Africa. Presented by Hon. W. Stanley Hollis, United States consul. Received February 23, 1905.

A Lourenço Marquez fruit tree.

12963 to 12970.

From Philadelphia, Pa. Received thru W. A. Burpee & Co., February 17, 1905.

Flower seeds for stock purposes.

12971 to 12987.

From New York, N. Y. Received thru J. M. Thorburn & Co., February 17, 1905.

Flower seeds for stock purposes.

12988. Antirrhinum majus. **Snapdragon.**

From Fairfield, Wash. Received thru Mr. E. H. Morrison, January 3, 1905.

12989. Cosmos bipinnatus. **Cosmos.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., January 10, 1905.

12990. KOCHIA SCOPARIA.

From Detroit, Mich. Received thru Mr. William McRobbie, gardener of the Palmer Park Gardens, November 7, 1904.

12991. MEDICAGO SATIVA. **Alfalfa.**

From Excelsior, Minn. Received thru Mr. A. B. Lyman, February 24, 1905.

Grimm. A variety attracting attention in the Northwest. (See Bulletin (press), No. 20, University Exp. Sta., St. Anthony Park, Minn., March, 1904, on Hardy Alfalfa in Minnesota.)

12992. MEDICAGO SATIVA. **Alfalfa.**

From Bassorah, Arabia. Secured thru H. P. Chalk, esq., American consular agent. Received February 27, 1905.

"From preliminary tests of this alfalfa, made from a previous importation, under S. P. I. No. 8806, it seems probable that this particular strain will make a more rapid growth than the ordinary varieties cultivated in this country and may prove especially valuable for certain regions in southern California and Arizona. These preliminary experiments have been carried on at the Pomona substation in California, where this variety, together with the ordinary and the Turkestan varieties, planted side by side at the same time, exhibited most unusual rapidity of growth." (*Fairchild.*)

12993. HORDEUM DISTICHUM NUTANS. **Two-row barley.**

From Minneiska, Minn. Received thru Mr. H. L. Whitman, February 23, 1905.

Hanna.

12994. ANEMONE ALPINA SULPHUREA.

From Carsethorn, Dumfries, Scotland. Presented by Mr. Samuel Arnott. Received February 25, 1905.

12995 and 12996. PINGUICULA spp.

From Mexico. Presented by Dr. J. N. Rose. Received February 15, 1905.

12995. PINGUICULA sp. **12996.** PINGUICULA CAUDUTA.

12997. SPREKELIA FORMOSISSIMA.

From Mexico. Presented by Dr. J. N. Rose. Received February 15, 1905.

"This is an old garden favorite, but is especially interesting, as it comes from the high mountains of central Mexico. The home of this species is usually given as South America or Guatemala. Only one species of Sprekelia is recognized by J. G. Baker and other writers on this group, but there are certainly two, if not more, very distinct species. This plant has flowered in Washington several times. The flowers are large, nearly 4 inches long, and deep crimson. It differs only slightly from descriptions. The bulb scales are black, not brown, as usually given. Bulbs were collected in a shallow mountain swamp of central Mexico in 1903 (No. 813)." (*Rose.*)

12998 and 12999. PUNICA GRANATUM. **Pomegranate.**

From Degach (El Oudiane), Tunis. Received thru Mr. T. H. Kearney, March 7, 1905.

12998. *Gabsi.*

A variety having large, pale-red fruit. "The Gabsi is very likely the same 'variety from Gabes,' of which I sent cuttings (S. P. I. No. 12566) in December from Susa." (*Kearney.*)

12999. *Tunisi.*

"A variety smaller than the preceding and having deep-red fruit. Both varieties were obtained at Degach (El Oudiane), the oasis of the Jerid most renowned for its pomegranates, oranges, and olives, while Tozer is celebrated for its figs. These are the two most widely grown kinds here (Tozer). The pomegranates of Gafsa are even more celebrated." (*Kearney.*)

13000. Brassica oleracea botrytis. **Cauliflower.**

From Copenhagen, Denmark. Received thru Mr. A. Hansen, seedsman, February 27, 1905.

Dwarf Erfurt.

13001. Lycopersicum esculentum. **Tomato.**

From Danville, Ky. Received from Mrs. W. B. Thomas, thru Mr. H. Giovannoli, of the United States Treasury Department, March 1, 1905.

Sample of tomato seed grown from seed distributed by the Department of Agriculture in 1891.

13002 to 13006. Citrus hyb.

From Glen St. Mary, Fla. Propagated by Mr. G. L. Taber, for distribution by the Office of Seed and Plant Introduction and Distribution. Received December 16, 1904.

Hybrid citrus fruits developed by Dr. H. J. Webber, in charge of the Department Plant Breeding Laboratory. Of these hybrids two are called hardy and two are tender. None are true oranges except the two tangerines, *Weshart* and *Trimble.* The hardy varieties constitute a new group designated by Doctor Webber as citranges. They are the *Rusk* and the *Willits.*

The fifth of the lot is a representative of a new group called the "tangelo," being a hybrid between the tangerine and the pomelo. The variety has been called the *Sampson.*

Doctor Webber describes the varieties as follows:

13002.

The *Rusk* citrange (P. B. No. 716) is a hybrid between the common sweet orange (female parent) and the trifoliate orange (male parent). The tree resembles that of the trifoliate orange in character, having trifoliate leaves which are much larger than those of the ordinary trifoliate. It is very productive and bears a small fruit about 2 to 2½ inches in diameter, which is somewhat similar to the tangerine. The fruit is nearly seedless, having only one seed to two fruits, and is very juicy, yielding a much larger quantity of juice than the best lemons of the same size. It makes a very pleasant citrangeade, and can be used for making pies, marmalades, jellies, and for other culinary purposes. Eaten with sugar, it is a very desirable breakfast fruit.

13003.

The *Willits* citrange (P. B. No. 777) is a hybrid between the trifoliate orange (female parent) and the common sweet orange (male parent), being thus the reciprocal hybrid of the *Rusk* citrange. The tree, as in the case of the *Rusk*, is similar to the trifoliate, but with much larger leaves, and it is semi-evergreen. The fruit is nearly seedless, having an average of only one seed to about four fruits. The fruit is slightly larger than the *Rusk*, the largest being about 2½ inches in diameter. The pulp is of a different color from the *Rusk*, being a lemon yellow. The flavor is also much more acid. The fruit is valuable for making citrangeade, pies, marmalades, jellies, and for other culinary purposes. It is too acid to be eaten out of hand.

13004.

This is one of our new hybrid citrus fruits, produced by crossing the tangerine and pomelo. The fruit differs from either parent, but combines the qualities of both. Differing from any other type of citrus fruit, it has been referred to a new group termed the "tangelo" group, and this particular variety has been designated the *Sampson.* The "Sampson tangelo" (P. B. No. 1316) forms a tree resembling in all essential characters the ordinary orange, and is as easily injured by cold. The fruit is about the size of the navel orange but of lighter color, being intermediate in size and color between the tangerine and pomelo. The flavor is sprightly acid, like the grapefruit, but with a slight suggestion of the bitter of that fruit. A striking and highly desirable characteristic is its easily removable rind, derived from the tangerine parent, so that it might be called a "kid-glove" pomelo. It is a tender tree and adapted to distribution in the present citrus-growing regions of Florida and California.

13002 to 13006—Continued.

13005 and 13006. *New tangerine oranges.*

No. 13005 (P. B. No. 628) has been named the *Weshart*, and No. 13006 (P. B. No. 627) has been named the *Trimble*.

A large number of hybrids have been made in the course of the investigations between the tangerine and various varieties of the sweet orange, with the object of producing an orange having the quality and character of the sweet orange with the loose, easily removable rind of the tangerine. Among the different hybrids which have thus far fruited, two have produced fruits which in all respects resemble true tangerines but are two weeks earlier than the earliest tangerines, and are larger, richer in color, and of rather superior quality.

13007 to 13026.

From Philadelphia, Pa. Received thru Henry A. Dreer (Incorporated), February 28, 1905.

A collection of flower seeds to be grown for stock.

13027 to 13034. SOLANUM TUBEROSUM. **Potato.**

From Auchtermuchty, Scotland. Received thru Prof. L. R. Jones, of the Vermont Experiment Station, March 3, 1905.

A collection of European potatoes for breeding purposes, as follows:

13027.

British Queen. (L. R. Jones's No. 43.) Originated by Findlay. Second early; white skin and flesh; kidney; quality reputed excellent and yield good. "Best second early in cultivation in England to-day," according to one high authority. Mr. Findlay claims that it is highly disease resisting, but others do not so consider it. Especially commended for trial in Florida, etc.

13028.

Royal Kidney. (L. R. Jones's No. 44.) Originated by Findlay, 1901. Late second early; white; quality excellent; yield good. Mr. Findlay claims this to be one of the hardiest disease-resisting varieties he has sent out. Commended for trial both in the North and South, as well as in Colorado.

13029.

Empire Kidney. (L. R. Jones's No. 45.) One of Findlay's recent varieties, and especially recommended by him as disease resisting and worthy of trial. Heavy yielder; good quality; said to be best on fertile loam. Selected especially for trial in the North and West, rather than in the South.

13030.

Evergood. (L. R. Jones's No. 46.) Originated and sent out by Findlay, about 1899. Medium late; white; oval; high quality; heavy cropper. Characterized by prolonged autumnal growth if the season favors. Commended by Mr. Findlay and others as disease resisting. Selected especially for trial in the North and West.

13031.

Goodfellow. (L. R. Jones's No. 47.) Originated by Mr. Findlay. Medium late; white skin and flesh; round; quality fine; yield good. Characterized by Mr. Findlay and others as disease resisting. Selected especially for trial in the North and West.

13032.

Up-to-Date. (L. R. Jones's No. 48.) One of Findlay's varieties sent out many years ago and now one of the standard main crop varieties of England. Commended as still in a fair degree disease resisting, altho past its prime in this respect. Medium late; white; excellent quality; strong yielder. Commended especially for trial in the North and West.

13027 to 13034—Continued.

13033.

Northern Star. (L. R. Jones's No. 49.) Medium late; white; round; quality and yield reputed excellent. One of Mr. Findlay's most promising recent introductions (first sent out in 1902). He says "the most disease-resisting potato I have ever known." Some others who have tried it are less optimistic as to this. Commended especially for trial in the North and West.

13034.

Eldorado. (L. R. Jones's No. 50.) Findlay's introduction (1903), and the most advertised potato in England to-day. Sold last year at rate of £200 sterling per pound weight. Medium late; white; elongated oval. Reputed of high quality and yield. Commended most highly by Mr. Findlay as disease resisting, but some others who have watched it are less hopeful of any remarkable characteristics in this direction.

13035 to 13076. ORYZA SATIVA. **Rice.**

From Formosa. Presented by the Agricultural Department of the Formosan Government, thru Mr. Fred. Fisher, United States consul at Tamsui, Formosa. Received March 2, 1905.

The first 20 numbers of this collection are "first crop" and the remainder are "second-crop" samples.

13035. *Chieng Yu.*

From Kirai Sho, Kokansho Seichuri, Ako Prefecture. Clayish soil.

13036. *Pei Cham.*

From Shinsho Shisho, Daichikuri, Hozan Prefecture. Sandy clay soil.

13037. *Chieng Yu.*

From Saikosho, Koryngairi, Hozan Prefecture. Sandy clay soil.

13038. *O Kaku.*

From Ryosan jusho, Rankoho, Taichu Prefecture. Sandy soil.

13039. *Tso Toa Hoe.*

From Sankaitsusho, Emmukabo, Shoka Prefecture. Sandy soil.

13040. *O Kaku.*

From Eibansho Kochokuho, Taihoku Prefecture. Clayish soil.

13041. *Kuai Kan Otowa.*

From Gynhosho, Chikuhoku Itsupo, Shinchiku Prefecture. Sandy soil.

13042. *Pei Bei Fun.*

From Dorawan Sho, Bioritsu Prefecture. Sandy soil.

13043. *Sam Sai.*

From Shinsho, Hokutoho, Nanto Prefecture. Sandy soil.

13044. *O Cham Ko.*

From Tosei Kosho, Dabyo Nanho, Kagi Prefecture. Sandy soil.

13045. *Pa Tei Don.*

From Chuhosho Kagi Toho, Kagi Prefecture. Clayish soil.

13046. *Nun Key.*

From Chinshi, Manrikisho, Enzanho, Gilan Prefecture. Sandy soil.

13047. *An Ka Tsu.*

From Saikosho, Koryugairi, Hozan Prefecture. Sandy clay.

13048. *Pei Gya Nun.*

From Ryo Sanjusho, Rankoho, Taichu Prefecture. Sandy soil.

13035 to 13076—Continued.

13049. *Check Shey.*

From Kokasho Shiran Sampo, Taihoku Prefecture. Lavitic mixt with clayish soil.

13050. *Jippon Tsu.*

From Gynhoshu, Chikuho, Itsupo, Shinchiku Prefecture. Sandy soil.

13051. *Ban Hoe.*

From Lanrisho, Bioritsu Niho, Bioritsu Prefecture. Sandy soil.

13052. *Pei.*

From Horishagai, Horishaho, Nanto Prefecture. Clayish soil.

13053. *Ran Hoe Tsu.*

From Shanshi Kyakusho, Dabyo Nanho, Kagi Prefecture. Sand and loam.

13054. *Ban Hoe.*

From Iketsusho, Shiiho, Gilan Prefecture. Clayish soil.

13055. *Tsu Pian.*

From Kaihosho, Seichuri, Akoku, Ako Prefecture. Sandy soil.

13056. *Pa Chiam.*

From Shintosen Sho, Seikari, Hozan Tsuku, Hozan Prefecture. Sandy soil.

13057. *O Kaku.*

From Gokosho, Daichikuri, Hozan Prefecture. Sandy clay.

13058. *Pei Kaku.*

From Hyoshitoyo Daimokukori, Tainan Prefecture. Sandy soil.

13059. *Go Ki Tsoa.*

From Horishagai, Horishoho, Nanto Prefecture. Clayish soil.

13060. *O Kaku.*

From Nantogai, Nantoho, Nanto Prefecture. Clayish soil.

13061. *U Kyo.*

From Nantogai, Nantoho, Nanto Prefecture. Clayish soil.

13062. *Shun Tsui Ban.*

From Sotosho, Hokutoho, Nanto Prefecture. Clayish soil.

13063. *Shi Kin Tsai.*

From Shikyotosho, Shushuho, Nanto Prefecture. Clayish soil.

13064. *Chino.*

From Shikyotosho, Shushuho, Nanto Prefecture. Clayish soil.

13065. *O Ka Hoe Rai.*

From Dakusuisho, Sarenkaho, Nanto Prefecture. Clayish soil.

13066. *Ban Na.*

From Shinsho, Hokutoho, Nanto Prefecture. Clayish soil.

13067. *Chien Yu.*

From Shinkogai, Siiho, Kagi Prefecture. Clayish soil.

13068. *O Kau.*

From Chuhosho, Kagiho, Kagi Prefecture. Clayish soil.

13069. *Toa Tsu.*

From Boryo, Boryosho, Tokari, Ako Prefecture. Loamy soil.

13070. *Toa Tsu.*

From Shinsho Shisho, Daichikuri, Hozan Prefecture. Sandy clay soil.

13035 to 13076—Continued.

13071. *Pei Tsu.*

From Gokosho, Daichikuri, Hozan Prefecture. Sandy clay soil.

13072. *Cha Ah Tsu.*

From Sankai Tsusho, Emmukaho, Shoka Prefecture. Sandy soil.

13073. *Tao Ro.*

From Shojibokuko, Naisho Shisho, Gai Shinka Nanri, Tainan Prefecture. Clayish soil.

13074. *Hon Hoe.*

From Nairokusho, Nantoho, Nanto Prefecture. Clayish soil.

13075. *Gya Loon.*

From Nairokusho, Nantoho, Nanto Prefecture. Clayish soil.

13076. *Pei Tsu*

From Kobo Suido, Dabyo Nanho, Kagi Prefecture. Sandy soil.

NOTE.—In the above list, Nos. 13035 to 13046 and 13055 to 13068 were marked "*Oryza utilissima*," while Nos. 13047 to 13054 and 13069 to 13076 were labeled "*Oryza glutinosa*."

13077. KOCHIA SCOPARIA.

From Takoma Park, D. C. Grown by Mr. A. J. Pieters during the season of 1904 for stock purposes.

13078. AGARICUS sp. **Mushroom.**

From Tokyo, Japan. Received thru Mr. T. Watase, president of the Tokyo Plant, Seed, and Implement Company, March 7, 1905.

"*Shiitake.*" "Spawn of the edible species of Japanese mushroom, which is cultivated on an immense scale in the forests of Japan. It is a tree-inhabiting fungus and the Japanese have developed a special system of culture by means of which they can produce immense quantities at little expense. This spawn was introduced especially for the experiments of Dr. B. M. Duggar, of the Agricultural Experiment Station, Columbia, Mo., and is well worth calling to the attention of the mushroom growers of America, who should be given a chance to test this in comparison with the ordinary *A. campestris*, which is grown almost exclusively on beds of manure. This variety of Agaricus is keenly relished, not only by Japanese but by Europeans living in Japan." (*Fairchild.*)

13079. GOSSYPIUM sp. **Cotton.**

From Lourenço Marquez, East Africa. Presented by Hon. W. Stanley Hollis, United States consul. Received March 3, 1905.

"From the slopes of the Lebombo Mountains, in the district of Lourenço Marquez." (*Hollis.*)

13080 to 13083. IPOMOEA HEDERACEA. **Japanese morning-glory.**

From Yokohama, Japan. Received thru the Yokohama Nursery Company, March 6, 1805.

13080. Common single.

13081. Double.

13082. Giant.

13083. Single fringed.

13084. SECHIUM EDULE. **Chayote.**

From Mayaguez, P. R. Received thru Mr. O. W. Barrett, of the Agricultural Experiment Station, March 8, 1905.

Fruits secured from Mr. S. van L. Lippitt, of Mayaguez, P. R.

13085. XANTHOSOMA SAGITTIFOLIUM. **Yautia.**

From Mayaguez, P. R. Received thru Mr. O. W. Barrett, of the Agricultural Experiment Station, February 27, 1905.

Rolliza. Tubers of the native Porto Rican Yautia "No. 1," from selected plants showing no sign of any fungous disease and growing in new soil. (For description, see No. 15417.)

13086. COLOCASIA sp. **Taro.**

From Mayaguez, P. R. Received thru Mr. O. W. Barrett, of the Agricultural Experiment Station, February 27, 1905.

Tubers of the *Dasheen* Colocasia from Trinidad, British West Indies. (For description, see No. 15395.)

13087. PYRUS MALUS. **Apple.**

From Amassia, Asia Minor. Presented by Mr. H. Caramanian. Received March 11, 1905.

Misket. "We found it to be a sweet apple of very firm texture and of rather ordinary quality. We do not consider it equal in quality to such varieties as *Lady Sweet, Winter Paradise, Victoria, Green Sweet,* or *Tolman.* It may have value for warm climates, however, and on this account I think it would be well to place scions of it for fruiting as quickly as possible by top-working on bearing trees at some representative southern points." (*W. A. Taylor.*)

13088. ALLIUM CEPA. **Onion.**

From Santa Clara, Cal. Received thru C. C. Morse & Co., March 15, 1905.

Grown from S. P. I. No. 9318.

13089. RHEUM OFFICINALE. **Rhubarb.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., March 15, 1905.

13090. AVENA SATIVA. **Oat.**

From Lincoln, Nebr. Received thru Prof. T. L. Lyon, Agricultural Experiment Station, March 10, 1905.

Kherson.

13091. AVENA SATIVA. **Oat.**

From Brandon, Wis. Received thru Mr. F. E. Jones, March 16, 1905.

Swedish Select. Grown from S. P. I. No. 2788. In the spring of 1899 Mr. David Jones, Brandon, Wis., planted an ounce of No. 2788. Thirty-two seeds grew, and from this little plot he and his neighbors raised 200,000 bushels of oats in 1904.

13092. AGROPYRON TENERUM. **Slender wheat-grass.**

From Brandon, Manitoba. Received thru A. E. McKenzie & Co., March 16, 1905.

13093. RHEUM PALMATUM TANGHUITICUM. **Rhubarb.**

From Paris, France. Received thru Messrs. Vilmorin-Andrieux & Co., March 17, 1905.

13094. GOSSYPIUM HIRSUTUM. **Cotton.**

From Guatemala. Received thru Mr. O. F. Cook, March 17, 1905.

Rabinal. "Cultivated by the Quiche Indians of Rabinal and other neighboring places of the dry plateau region of central Guatemala. A variety of the Upland type, grown as an annual crop, tho really a perennial. The stalks are cut back to the ground every year. The new shoots set flowers and fruit with great promptness, which, with the assistance of the native turkeys, enable a crop to be secured in spite of the presence of the boll weevil.

"This variety may be of interest in southern and southwestern Texas, either as a perennial or an annual. Even in the first year it is likely to be an early-maturing sort." (*Cook.*) (No. 1.)

13095. GOSSYPIUM HIRSUTUM. **Cotton.**

From Guatemala. Received thru Mr. O. F. Cook, March 17, 1905.

Kekchi. "Grown by the Indians at Secanquim, Cajabon district, Alta Vera Paz, Guatemala, the original locality of the weevil-eating keleps. This variety is of dwarf habit. It begins fruiting while still very young, and matures a crop in six months even in a humid tropical climate where other kinds of cotton would probably require a much longer time. It is expected that in the United States this will prove to be an extra-early variety, tho two or three years of acclimatization may be required. Of the varieties now in the United States the *Kekchi* cotton most nearly resembles the *King*, but it seems to possess the desirable qualities of that variety to an even greater degree and the lint is longer and of better quality." (*Cook.*) (No. 2.)

13096. GOSSYPIUM HIRSUTUM. **Cotton.**

From the market of Coban, Alta Vera Paz, Guatemala. Received thru Mr. O. F. Cook, March 17, 1905.

"Supposed to have been grown in the valley of the Polochic River. Probably similar to the *Kekchi* cotton, tho the Indians belong to another tribe." (*Cook.*) (No. 3.)

13097. GOSSYPIUM HIRSUTUM. **Cotton.**

From Retalhuleu, Guatemala. Received thru Mr. W. R. Maxon, March 17, 1905.

Pachon. "The variety most extensively grown in the western part of Guatemala, where a considerable cotton industry exists. Mr. Maxon was informed that this variety was originally introduced into Guatemala from Peru, but an examination of specimens shows that it is an Upland form similar to the *Kekchi* cotton and with the same weevil-resisting adaptations. It is said to mature a crop in five months." (*Cook.*) (No. 4.)

13098. GOSSYPIUM HIRSUTUM. **Cotton.**

From Retalhuleu, Guatemala. Received thru Mr. W. R. Maxon, March 17, 1905.

Ixcacco. "A brown cotton of the Upland type, similar to the brown form of the *Kekchi* cotton. The cotton brings the same price as the *Pachon* and is thought to have a stronger lint." (*Maxon.*) (No. 5.)

13099. GOSSYPIUM HIRSUTUM. **Cotton.**

From Retalhuleu, Guatemala. Received thru Mr. W. R. Maxon, March 17, 1905.

"Seeds of a supposed hybrid between *Pachon* and *Ixcacco* cotton. A single boll of this type was found on a plant the other bolls of which were white and apparently pure *Pachon.*" (*Maxon.*) (No. 6.)

13100. GOSSYPIUM HIRSUTUM. **Cotton.**

From Retalhuleu, Guatemala. Received thru Mr. W. R. Maxon, March 17, 1905.

"A smooth-seeded variation of *Pachon* cotton said to occur sporadically in the fields of the hairy-seeded form. The fiber is said to be not quite so long as the regular *Pachon.* This form is popularly believed to be that originally cultivated by the Indians in this locality." (*Maxon.*) (No. 7.)

13101. GOSSYPIUM HIRSUTUM. **Cotton.**

From Cucanha, near Tucura, Guatemala. Received thru Mr. O. F. Cook, March 17, 1905.

"A cotton similar to *Kekchi* grown in the valley of Polochic River." (*Cook.*) (No. 8.)

13102. MESEMBRYANTHEMUM GEMINATUM (?).

From Sfax, Tunis. Received thru Mr. T. H. Kearney, March 17, 1905.

"Cuttings of a variety of Mesembryanthemum that is used for making lawns on land that is so alkaline that deposits of white alkali may be seen beneath the mat of the plant. I believe this will be valuable as a cover for alkaline soils." (*Fairchild.*)

13103. CARICA PAPAYA. **Papaw.**

From Esmeraldas, Ecuador. Presented by Mr. George D. Hedian. Received March 16, 1905.

13104. ALEURITES CORDATA. **Tung-shu or wood-oil tree.**

From Hankow, China. Presented by Consul-General L. S. Wilcox and received at Chico, Cal., March 18, 1905.

"The fruit of this tree is the source of "wood oil," which is being imported in large quantities by this country, where it is used in the manufacture of paints, fine varnishes, and soaps. The tree itself is of stately appearance, with green, smooth bark and spreading branches, making it one of the finest of shade trees. It has been styled, and worthily so, "the national tree of China." The Tung-shu flourishes thruout the Yangtze Valley in latitude 25° to 34° N. It is said not to bear when subjected to temperatures as low as 20° F., altho it will stand any degree of heat. The trees are raised from seed in a bed and transplanted when about a foot high, and seem to do well in almost any kind of soil. The Tung-shu is also propagated by cuttings. It is a rapid grower and will come into bearing in from three to six years, much depending upon the fertility of the soil. The yield of nuts from an average tree may be put at anywhere from 20 to 50 pounds, while the percentage of oil obtained from the nut is 40 per cent. The Chinese find a great many other uses for the oil of this tree; also for its wood and the refuse from the wood oil nut after extraction of the oil. Persons growing the wood oil tree should be cautioned against allowing the oil to come in contact with the skin, as it is extremely poisonous." (*Wilcox.*)

13105. SOLANUM COMMERSONI. **Aquatic potato.**

From Burlington, Vt. Presented by Prof. William Stuart, Agricultural Experiment Station, thru Mr. W. A. Orton. Received March 21, 1905.

13106. LILIUM hyb. **Lily.**

Seedlings resulting from pollinating flowers of *Lilium longiflorum eximium giganteum* (S. P. I. No. 11583) with *Lilium harrisii.* Crossing done by Mr. G. W. Oliver in the Department greenhouse during 1904.

13107. PAPAVER SOMNIFERUM. **Poppy.**

From Philadelphia, Pa. Received thru Powers, Weightman & Rosengarter, March 21, 1905.

Opium seed from Asia Minor.

13108 to 13115. ROSA hyb. **Rose.**

From Sawbridgeworth, Herts, England. Received thru Thomas Rivers & Son, The Nurseries, March 23, 1905.

13108. *Conrad F. Meyer.*
13109. *Fimbriata.*
13110. *Mrs. Anthony Waterer.*
13111. *Rose Apples.*
13112. *Souv. de Christophe Cochet.*
13113. *Blanche de Coubert.*
13114. *Thusnelda.*
13115. *Repens Alba.*

13116 to 13129. Rosa hyb. **Rose.**

From Herts, England. Received from William Paul & Son, Waltham Cross, March 23, 1905.

13116. *Etoile de France.*
13117. *Countess Cairns.*
13118. *Earl of Warwick.*
13119. *Irene.*
13120. *Mrs. A. Byass.*
13121. *America.*
13122. *Atropurpurea.*
13123. *Belle Poitevine.*
13124. *Blanc Double de Coubert.*
13125. *Calocarpa.*
13126. *Chedane Guinoisseau.*
13127. *Mercedes.*
13128. *New Century.*
13129. *Rugosa Regliana.*

13130 and 13131. Castanea spp. **Chestnut.**

Received from Mr. T. E. Steele, Palmyra, N. Y., March 24, 1905.

13130. Castania crenata. Seedling Japanese chestnut.
13131. Castania sativa. Seedling Spanish chestnut.

13132. (Undetermined.) **Matondo.**

From Melsetter, Rhodesia, South Africa. Presented by Mr. W. M. Longden. Received March 23, 1905.

A fruit by the name of "Matondo," described by Mr. Longden as follows: "The tree is a large, evergreen one, casting a dense shade. It grows to a height of about 60 feet, has a spreading habit, and is a prolific bearer. Fruit oval in shape, with a smooth skin and faint veins; color when ripe, yellow; dark green when unripe. Size up to 3 inches by 2 inches in diameter. Peel tough and thick, not edible; exudes milky fluid, very bitter and distasteful. Flesh edible, jelly-like in appearance, sweet and pleasant to taste. It grows in the Sabi Valley principally, at an altitude of about 1,800 feet, where the climate is very warm and there is comparatively no frost."

"This fruit should be experimented with in Porto Rico, Hawaii, and southern California." (*Fairchild.*)

13133. Vitis sp. **Grape.**

From Algeria, North Africa. Presented by Dr. L. Trabut and forwarded by Mr. T. H. Kearney. Received March 27, 1905.

Boufarik (table). A desert-resistant grape.

13134. Agaricus sp. (?) **Mushroom.**

From Yokohama, Japan. Received thru Yokohama Nursery Company, March 27, 1905.

13135. Garcinia mangostana. **Mangosteen.**

From Buitenzorg, Java. Received thru Doctor Treub, March 24, 1905

13136 to 13142.

From Melsetter, Rhodesia, South Africa. Presented by Mr. W. M. Longden. Received March 27, 1905.

A collection of fruit trees, with descriptions by Mr. Longden, as follows:

13136. (Undetermined.) **Ivory nut.**

"It (the nut) grows on a palm tree, which sometimes reaches a height of 60 feet. The natives eat the spongy substance between the skin and kernel. The vegetable ivory is, I think, an article of commerce."

13136 to 13142—Continued.

13137. Anona sp. **Custard-apple.**

"Edible. Tree very much resembles the domestic variety; fruit has a delightful flavor."

13138. Ficus sp. **Fig.**

"Edible. Grows on the river banks. These have a sweet flavor. There is also another variety larger, perhaps, than any domestic fig. They are comparatively flavorless."

13139. (Undetermined.) **"Wild plum."**

"Edible. Tree very similar to your persimmon. Natives also eat the kernel, which has a nutty flavor with a touch of almond, and contains a large percentage of oil, which the natives extract."

13140. Euphorbia sp. (?). **"Footah."**

"Fruit is used by the natives for making a pleasant drink by soaking the ripe seeds in water, which turns milky when stirred. Seeds are also crusht for oil, of which they contain a large quantity. Tree grows to a height of about 50 feet; dense, shiny, dark-green foliage giving immense shade."

13141. (Undetermined.) **"Mutwzwa."**

"Edible. Flavor somewhat similar to damson. Grows in stony ground; bush about 7 feet in height."

13142. (Undetermined.) **"Eecha."**

"Species of nut. May be eaten raw, but is usually roasted by the natives. It is only to supplement food supplies in lean years."

13143 to 13153. Zea mays. **Sweet corn.**

First generation from S. P. I. Nos. 12557 and 12558. Distributed during the season of 1905 for further trial to test the effects of soil, location, etc.

13143 to 13147. *Stowell's Evergreen.* Grown from S. P. I. No. 12557.

13143. Received from Prof. J. C. Whitten, Columbia, Mo., February, 1905.

13144. Received from Mr. J. C. Robinson, Waterloo, Nebr., February, 1905.

13145. Received from Prof. R. A. Emerson, Lincoln, Nebr., February, 1905.

13146. Grown on the Arlington Farm during the summer of 1904.

13147. Received from A. Mitchelson & Son, Tariffville, Conn., February, 1905.

13148 to 13153. *Early Crosby.* Grown from S. P. I. No. 12558.

13148. Received from Prof. C. P. Ball, Minneapolis, Minn., February, 1905.

13149. Received from Prof. R. A. Emerson, Lincoln, Nebr., February, 1905.

13150. Received from A. Mitchelson & Son, Tariffville, Conn., February, 1905.

13151. Received from Mr. J. C. Robinson, Waterloo, Nebr., February, 1905.

13152. Received from Prof. J. C. Whitten, Columbia, Mo., February, 1905.

13153. Grown on the Arlington Farm during the summer of 1904.

13154. Pistacia sp. **Pistache.**

From Aintab, Turkey. Presented by Rev. A. Fuller thru Mr. Walter T. Swingle. Received March 27, 1905.

13155. Rhus copallina. **Sumac.**

From Austin, Tex. Presented by Mr. F. T. Ramsey. Received March 27, 1905.

13156 to 13158.

From Amassia, Turkey. Presented by Mr. H. Caramanian. Received March 29, 1905.

13156. Pyrus malus. **Apple.**

13157. Prunus domestica. **Plum.**

Uryány. (See S. P. I. No. 10526.)

13158. Cydonia sp. **Quince.**

Adjem.

13159 to 13236. Iridaceae.

From Yokohama, Japan. Received thru Suzuki & Iida, New York, N. Y., March 25, 1905.

13159 to 13226. Iris kaempferi. **Iris.**

13159.	*Gekka-no-nami.*
13160.	*Shishi-odori.*
13161.	*Kumoma-no-sora.*
13162.	*Kumo-no-obi.*
13163.	*Ho-o-jo.*
13164.	*Gei-sho-ui.*
13165.	*Sofu-no-koi.*
13166.	*Manadsuru.*
13167.	*Hana-no-nishiki.*
13168.	*Yomo-no-umi.*
13169.	*Meiran.*
13170.	*Kuma-funjin.*
13171.	*Taiheiraku.*
13172.	*Hana-aoi.*
13173.	*Uchiu.*
13174.	*Osho-kun.*
13175.	*Shippo.*
13176.	*Kumo-isho.*
13177.	*Kiji-no-megumi.*
13178.	*Kumo-no-uye.*
13179.	*Yezo-nishiki.*
13180.	*Shishi-ikari.*
13181.	*Oniga-shima.*
13182.	*Sano-watashi.*
13183.	*Yedo-jiman.*
13184.	*Senjo-no-hora.*
13185.	*O-torige.*
13186.	*Shirataki.*
13187.	*Shiga-no-uranami.*
13188.	*Kagaribi.*
13189.	*Kosui-no-iro.*
13190.	*Komochi-guma.*
13191.	*Kakujakuro.*
13192.	*Momiji-no-taki.*
13193.	*Shichiukwa.*
13194.	*Yedo-kagami.*
13195.	*Uji-no-hotaru.*
13196.	*Shimoyo-no-tanki.*
13197.	*Tsurugi-no-mai.*
13198.	*Iso-no-nami.*
13199.	*Oyodo.*
13200.	*Bandai-no-nami.*
13201.	*Wakamurasaki.*
13202.	*Kyodaisan.*
13203.	*Kigan-no-misao.*
13204.	*Koki-no-iro.*
13205.	*Samidare.*
13206.	*Tora odori.*
13207.	*Tsuru-no-kegoromo.*
13208.	*Datedogu.*
13209.	*Ayase-gawa.*
13210.	*Ho-dai.*
13211.	*Nishiki-hitone.*
13212.	*Riubi.*
13213.	*Renjo-no-tama.*
13214.	*Yomo-zakura.*
13215.	*Shige-no-yuki.*
13216.	*Asa-kagura.*
13217.	*Sumida-gawa.*

13159 to 13236—Continued.

13159 to 13226—Continued.

13218. *Tsutsu-izutsu.*
13219. *Rinpo.*
13220. *Chitose-dsuru.*
13221. *Risho-no-tama.*
13222. *Kasu-gano.*
13223. *Asa-gasumi.*
13224. *Fuki-yose.*
13225. *Goko-no-asobi.*
13226. *Yamato-zukasa.*

13227 to 13235. Iris spp. **Iris.**

13227. Iris albo-purpurea.
13228. Iris albo-purpurea.
13229. Iris raphiolepis.
13230. Iris raphiolepis variegata.
13231. Iris gracilipes.
13232. Iris sibirica.
13233. Iris laevigata.
13234. Iris laevigata semperflorens.
13235. Iris laevigata alba.

13236. Belamcanda punctata.

13237. Medicago sativa. **Alfalfa.**

From Chinook, Mont. Received thru the Thomas O'Hanlon Company, March 30, 1905. Grown by George Davidson, near Chinook, in Milk River Valley, under irrigation.

13238 to 13240.

From Lourenço Marquez, Portuguese East Africa. Presented by Hon. W. Stanley Hollis, United States consul. Received March 27, 1905.

13238. Gossypium sp. **Cotton.**

"Native East African cotton seed, which was got for me from the slopes of the Lebombo Mountains by the Bishop of Lebombo." (*Hollis.*)

13239. Carissa arduina. **Amatungulu.**

"The 'Martingula,' which is highly esteemed here for eating fresh, as well as for making preserves." (*Hollis.*)

13240. (Undetermined.)

"I have to report that William F. Upshur, esq., of Barrene, Inhambane, has been good enough to furnish me with a small quantity of specimens of a new tree oil seed that is being exploited in the Inhambane district. In Inhambane these oil seeds are called 'Maferera'; in Mozambique, where they grow wild in great profusion, they are called 'Umtizi'; and in Lourenço Marquez, where they are eaten by the natives, they are called 'Umgushu.'" (*Hollis.*)

13241. Ulex europaeus. **Gorse, whin, or furze.**

From Dublin, Ireland. Received thru Hogg & Robertson, March 29, 1905.

13242. Cotoneaster angustifolia.

From Orleans, France. Received thru M. Léon Chénault, Route d'Olivet, 79, March 27, 1905.

13243 to 13255. Rosa sp. **Rose.**

From Worcester, England. Received thru Richard Smith & Co., March 30, 1905.

13243. *Madam George Bruant.*
13244. *Rugosa Alba.*
13245. *Rugosa, fl. pl.*
13246. *Madam Charles Worth.*
13247. *Rugosa Compte D'Empresnel.*

13243 to 13255—Continued.

13248. *Rugosa Rosea.*
13249. *Rugosa Rubra.*
13250. *Austrian Copper.*
13251. *Austrian Yellow.*
13252. *Harisoni.*
13253. *Persian Yellow.*
13254. *Souv. de Pierre Notting.*
13255. *Marechal Niel.*

13256. Zea mays. **Corn.**

From North Pomfret, Vt. Received thru Mr. S. Hewitt, February, 1905.

Malakof. Grown from S. P. I. Nos. 12562 and 12563.

13257. Olea europaea. **Olive.**

From Mustapha, Algeria, North Africa. Presented by Dr. L. Trabut. Received March 30, 1905.

Grosse Aberkan. Cuttings.

13258. Nephelium lappaceum. **Rambutan.**

From Buitenzorg, Java. Presented by Doctor Treub. Received March 31, 1905.

13259. Medicago sativa. **Alfalfa.**

From Milburn, Nebr. Received thru Mr. C. A. Snyder, April 1, 1905.

Seed grown in 1904 on Sec. 13, T. 20, R. 21, Custer County, Nebr., without irrigation, where it is 240 feet to water.

13260 to 13262. Zea mays. **Rice popcorn.**

From Sao Paulo, Brazil. Presented by Prof. A. Lofgren, Horto Botanico. Received March 25, 1905.

13260. *White.*
13261. *Amber.*
13262. *Red.*

13263 to 13265.

From Yokohama, Japan. Received thru Yokohama Nursery Company, April 3, 1905.

13263. Citrus sp. **Orange.**

Natsu daidai. (See S. P. I. No. 8903.)

13264. Juncus effusus. **Matting rush.**

13265. Scirpus triqueter.

13266 to 13285.

From Sultepec, Mexico. Presented by Mr. Federico Chisolm, Hacienda "Cabajal." Received March 28, 1905.

A collection of unidentified plants.

13286 to 13290.

From Philadelphia, Pa. Received thru Henry A. Dreer, Incorporated, April 3, 1905.

Flower seeds for growing seed.

13291. Medicago sativa. **Alfalfa.**

From Fayetteville, N. Y. Received thru Mr. F. E. Dawley, April 1, 1905.

13292. PERSEA GRATISSIMA. **Avocado.**

From Coban, Guatemala. Received thru Mr. G. N. Collins and Mr. C. B. Doyle, March, 1905.

"This thick-skinned type of avocado is very distinct from the varieties commonly found on the markets and from those grown in Florida, the West Indies, and Mexico. It is believed that they will stand shipping much better than the thinner-skinned sorts, and as the quality is fine they should be a valuable acquisition for Porto Rico and Hawaii." (*Collins.*)

13293 to 13297. CALADIUM ESCULENTUM. **Taro.**

From Magnolia, N. C. Received thru the Newberry Bulb Company, March 30, 1905.

13298. PUNICA GRANATUM. **Pomegranate.**

Received March 29, 1905, without advices, thru the Georgetown custom-house. Arrived in New York via steamship *Umbria*.

13299. STUARTIA PENTAGYNA.

From Morrisville, Pa. Received thru Mr. S. C. Moon, April 4, 1905.

13300 to 13303. PHALARIS CANARIENSIS. **Canary grass.**

From Marseille, France. Received thru Hon. Robert P. Skinner, United States consul-general, April 5, 1904.

13300. Cleaned seed from Rodosto, Turkey.

13301. Cleaned seed from Plata, Argentina.

13302. Ordinary seed from Rodosto, Turkey.

13303. Ordinary seed from Plata, Argentina.

"The exporters of canary seed (*Phalaris canariensis*) of Marseille handle only the imported grades, the best of which reach this city from Rodosto (Turkey). The Rodosto seed is richest and has scarcely any grain. The Plata seed has at times a better aspect than the Rodosto seed, but is much lighter, contains straw in excessive quantities, and the kernels are generally decorticated." (*Skinner.*)

13304 and 13305.

From Mustapha, Algeria. Presented by Dr. L. Trabut, government botanist. Received April 7, 1905.

13304. SAPINDUS UTILIS. **Soapberry.**

13305. NARCISSUS PACHYBOLBUS. **Narcissus.**

A vigorous species from western Algeria and Morocco, having 40 or 50 small flowers in clusters. Doctor Trabut thinks this will be interesting to cross with large-flowered varieties.

13306 to 13312. LATHYRUS ODORATUS. **Sweet pea.**

From Algiers, Algeria. Presented by Mr. Arkwright F. Telemly. Received April 7, 1905.

Early-maturing sweet peas, as follows:

13306. Blue and red.

13307. Blue.

13308. Rose and white.

13309. Lilac.

13310. Purple and bronze.

13311. Purple.

13312. Red.

13313 to 13315. Chrysanthemum leucanthemum hyb. **Shasta daisy.**

From Santa Rosa, Cal. Received thru Mr. Luther Burbank, April 7, 1905.

13313. *California.*
13314. *Westralia.*
13315. *Alaska.*

13316 to 13318.

From Lawrence, Kans. Received thru F. Barteldes & Co., April 7, 1905.

13316. Andropogon sorghum. **Sorghum.**

Amber.

13317. Andropogon sorghum. **Kafir corn.**

White.

13318. Andropogon sorghum. **Kafir corn.**

Red.

13319. Asparagus duchesnii.

From Brussels, Belgium. Received thru Mr. H. Schuster, 66 Rue du Luxembourg, April 8, 1905.

13320 to 13337. Rosa sp. **Rose.**

From Newtownards, County Down, Ireland. Received thru Alex. Dickson & Sons (Limited), Royal Irish Nurseries, April 8, 1905.

13320. *Dean Hole.*
13321. *Dr. J. Campbell.*
13322. *Hugh Watson.*
13323. *Lady Ashtown.*
13324. *Mrs. Conway Jones.*
13325. *Rev. David Williamson.*
13326. *Irish Engineer.*
13327. *Irish Harmony.*
13328. *Perle des Jannes.*
13329. *Baron Lade.*
13330. *Annie Marie Soupert.*
13331. *George Laine Paul.*
13332. *Le Progrès.*
13333. *Rugosa Delicata.*
13334. *Souv. de Pierre Leperdrieux.*
13335. *Schnechlecht.*
13336. *Andenkah Job Diering.*
13337. *Mme. Jean Dupuy.*

13338. Mangifera indica. **Mango.**

From Lucknow, India. Received from the Royal Botanical Gardens, thru Mr. Robert Anderson, Lansdowne, Pa., April 11, 1905.

Bombay.

13339. Lolium italicum. **Italian rye-grass.**

From New York, N. Y. Received thru J. M. Thorburn & Co., April 8, 1905.

13340. Meconopsis integrifolia. **Tibetan poppy.**

From Chelsea, England. Received thru James Veitch & Sons (Limited), August 14, 1905.

"English saved seed. A hardy yellow-flowered poppy from Tibet; hardy, biennial. The plant thrives on the north side of a hedge or wall and grows and flowers freely in open borders. The soil should be open and friable, with a large proportion of peat and sand. Good drainage and ample moisture are required. The seed germinates freely either in a cold frame or out of doors in a few weeks from the time of sowing. Any attempt at any time to protect the plants is quite fatal." (*Veitch & Sons.*)

13341 to 13345. CUCUMIS MELO. **Muskmelon.**

From Detroit, Mich. Received thru D. M. Ferry & Co., April 8, 1905.

13341. *Osage.*
13342. *Defender.*
13343. *Bay View.*
13344. *Baltimore.*
13345. *Emerald Gem.*

13346. HORDEUM DISTICHUM NUTANS. **Two-row barley.**

From Jena, Germany. Received from Doctor Broili, thru the Wahl-Henius Institute of Fermentology, Chicago, Ill., April 10, 1905.

Frankish Brewing. Presumably a high-grade pedigreed sort.

13347. BERBERIS sp. **Barberry.**

From Gloucester, Mass. Received thru Mr. R. P. Ireland, April 13, 1905.

13348. MANGIFERA INDICA. **Mango.**

From Seharunpur, India. Received thru Mr. W. Gollan, superintendent of the Government Botanical Gardens, April 13, 1905.

Bombay Yellow. Plants.

13349. GARCINIA XANTHOCHYMUS.

From Honolulu, Hawaii. Presented by Mr. Gerrit P. Wilder, April 13, 1905.

13350. OPUNTIA FICUS-INDICA (?). **Prickly pear.**

From Nice, France. Presented by Dr. A. Robertson-Proschowsky. Received April 10, 1905.

"Cuttings of a seedling cactus grown by Doctor Proschowsky from seeds received probably from Mexico. This variety has never been fruited, but is so nearly spineless that it may be of interest as a forage plant." (*Fairchild.*)

13351 to 13353. **Barberry.**

From Ottawa, Canada. Presented by Prof. William Saunders, director of the Central Experimental Farm. Received April 10, 1905.

13351. BERBERIS AMURENSIS.
13352. BERBERIS SINENSIS.
13353. BERBERIS SIEBOLDI.

13354. ZEA MAYS. **Popcorn.**

From Karachi, India. Presented by Mr. I. L. F. Beaumont, of the Municipal Gardens and Farm Committee. Received April 10, 1905.

13355. CUCUMIS MELO. **Muskmelon.**

From Lakin, Kans. Received thru Mr. William Logan, January 26, 1905.

Rocky Ford.

13356. VICIA SATIVA. **Common vetch.**

From New Era, Oreg. Received thru Mr. Henry Gilbrich, April, 1905.

White. Said to have been bred by selection from the common type.

13357. ZEA MAYS. **Sweet corn.**

From Winooski, Vt. Received thru Mr. M. E. Douglass, March 3, 1905.

Malakof. Grown from S. P. I. No. 9449. Second generation. "No other early corn nearer than 1 mile either in 1903 or 1904." (*D. S. Bliss.*)

13358. MEDICAGO SATIVA. **Alfalfa.**

From Agricultural College, N. Dak. Received from the North Dakota Agricultural Experiment Station, thru Mr. C. J. Brand, October 28, 1904.

Grimm.

13359 to 13566.

Seeds transferred April 15, 1905, from the Office of Grass and Forage Plant Investigations to the Office of Seed and Plant Introduction and Distribution.

13359. ANTHOXANTHUM ODORATUM. **Sweet vernal grass.**

From Germany, 1904. (Agrost. 2384). From the Louisiana Purchase Exposition, 1904.

13360. CEPHALARIA TATARICA.

Grown in U. S. D. A. grass garden, 1902. (Agrost. 307.)

13361. CEPHALARIA TATARICA.

Grown in U. S. D. A. grass garden, July, 1904. (Agrost. 307.)

13362 to 13369. CICER ARIETINUM. **Chick-pea.**

13362. Grown at Arlington Farm, 1902. (Agrost. 970–1.)

13363. From Parma, Italy. (Agrost. 2456.)

13364. From Voghera, Italy. (Agrost. 2457.)

13365. From Voghera, Italy. (Agrost. 2458.)

13366. From Avellino, Italy. (Agrost. 2459.)

13367. From Italy. (Agrost. 2460.)

13368. From Italy. (Agrost. 2461.)

13369. From Italy. (Agrost. 2462.)

13370. BROMUS MARGINATUS.

From Seattle, Wash. Received thru Mr. Henry N. Leckenby. (Agrost. 1886.)

13371 to 13376.

Received from Mr. S. W. Mollison, Inspector-General of Agriculture for India.

13371. DOLICHOS BIFLORUS.

Kulthi. From United Provinces of Agra and Oudh, India. (Agrost. 1646.)

13372. DOLICHOS BIFLORUS.

Kulthi. From Bombay Presidency, India. (Agrost. 1647.)

13373. DOLICHOS LABLAB. **Hyacinth bean.**

Popat. From Nagpur, Central Provinces, India, 1903. (Agrost. 1648.)

13374. DOLICHOS LABLAB. **Hyacinth bean.**

Sem. From United Provinces of Agra and Oudh, India, 1903. (Agrost. 1649.)

13375. DOLICHOS LABLAB. **Hyacinth bean.**

Val. From Bombay, India, 1903. (Agrost. 1650.)

13376. DOLICHOS LABLAB. **Hyacinth bean.**

Val. From Bombay, India, 1903. (Agrost. 1651.)

13377. HOLCUS LANATUS. **Velvet grass.**

Received thru the C. H. Lilly Company, Seattle, Wash., 1904. (Agrost. 2094.)

13359 to 13556—Continued.

13378. LATHYRUS SATIVUS. **Bitter vetch.**

From Catania, Italy, 1904. From Italian exhibit, Louisiana Purchase Exposition. (Agrost. 2389.)

13379. LATHYRUS CICER. **Winter flat pea.**

From Catania, Italy, 1904. From Italian exhibit, Louisiana Purchase Exposition. (Agrost. 2406.)

13380. PHASEOLUS CALCARATUS. **Bean.**

From the Alabama Agricultural Experiment Station. (Agrost. 2126.)

13381. PHASEOLUS CALCARATUS. **Bean.**

Grown at Arlington Farm, 1903, from S. P. I. No. 6564. (Agrost. 941-1 a 1.)

13382. PHASEOLUS CALCARATUS. **Bean.**

A selection grown at Arlington Farm, 1903, from S. P. I. No. 6564. (Agrost. 941-1 c 1.)

13383. PHASEOLUS CALCARATUS. **Bean.**

A selection grown at Arlington Farm, 1903, from S. P. I. No. 6564. (Agrost. 941-1 d 1.)

13384. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 969½-1 a 1.) Seeds yellow to light orange.

13385. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 969½-1 b 1.)

13386. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 969½-1 c 1.)

13387. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 969½-1 e 1.)

13388. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 969½-1 f 1.)

13389. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 969½-1 g 1.)

13390. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 969½-1 h 1.)

13391. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 1190-1.)

13392. PHASEOLUS sp. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 1191.)

13393. PHASEOLUS sp. **Bean.**

Special selection with large seeds grown at Arlington Farm, 1903. (Agrost. 1191-1.)

13394. PHASEOLUS RADIATUS. **Mung bean.**

Grown at Arlington Farm, 1903. (Agrost. 968.)

13395. PHASEOLUS RADIATUS. **Mung bean.**

From Clemson College, S. C., 1903. (Agrost. 1112.)

Newman.

13359 to 13556—Continued.

13396 and 13397.

Received from Mr. S. W. Mollison, Inspector-General of Agriculture in India.

13396. PHASEOLUS RADIATUS. **Mung bean.**

From United Provinces of Agra and Oudh, India, July 8, 1903. (Agrost. 1639.)

13397. PHASEOLUS RADIATUS. **Mung bean.**

From Nagpur, Central Provinces, India, 1903. (Agrost. 1640.)

13398. PHASEOLUS RADIATUS. **Mung bean.**

From Cedartown, Ga., November, 1904. (Agrost. 2130.)

13399 to 13403.

Received from Mr. S. W. Mollison, Inspector-General of Agriculture in India.

13399. PHASEOLUS RADIATUS. **Mung bean.**

Katikha. From United Provinces of Agra and Oudh, India, 1903. (Agrost. 1641.)

13400. PHASEOLUS MAX. **Mung bean.**

Bhadela. From United Provinces of Agra and Oudh, India, 1903. (Agrost. 1642.)

13401. PHASEOLUS MAX. **Mung bean.**

Jathia (*?*), or *Jettira.* From United Provinces of Agra and Oudh, India, 1903. (Agrost. 1643.)

13402. PHASEOLUS MAX. **Mung bean.**

Udid. From Bombay Presidency, India, 1903. (Agrost. 1644.)

13403. PHASEOLUS MAX. **Mung bean.**

Udid. From Nagpur, Central Provinces, India, July 8, 1903. (Agrost. 1645.)

13404. PHASEOLUS RETUSUS. **Metcalf bean.**

From Silver City, N. Mex., April 28, 1903. (Agrost. 1176.)

13405. PHASEOLUS ANGULARIS. **Bean.**

Grown at Arlington Farm, 1903. (Agrost. 941½.)

13406. VICIA sp. **Vetch.**

From Argentine exhibit, Louisiana Purchase Exposition. (Agrost. 2327.)

13407. VICIA sp. **Vetch.**

From German exhibit, Louisiana Purchase Exposition. (Agrost. 2455.)

13408. VICIA sp. **Vetch.**

Grown at Arlington Farm, 1902. (Agrost. 965; S. P. I. 6553.)

13409. VICIA sp. **Vetch.**

Grown at Arlington Farm, 1902. (Agrost. 942–1.)

13410. VICIA ERVILIA. **Black bitter vetch.**

From Italian exhibit, Louisiana Purchase Exposition, 1904. (Agrost. 2403.)

13411. VICIA FABA. **Horse bean.**

From Naples, Italy, 1904. From Italian exhibit, Louisiana Purchase Exposition. (Agrost. 2415.)

13412. VICIA SATIVA. **Common vetch.**

From Argentine exhibit, Louisiana Purchase Exposition. (Agrost. 2314.)

13413 to 13431. VICIA SATIVA. **Common vetch.**

From Italian exhibit, Louisiana Purchase Exposition.

13413. From Italy. (Agrost. 2388.)

13359 to 13556—Continued.

13413 to 13431—Continued.

13414. From Reggio nell' Emilia, Italy. (Agrost. 2390.)

13415. From Rome, Italy, 1904. (Agrost. 2391.)

13416. From Fabriano, Italy, 1904. (Agrost. 2392.)

13417. From Italy, 1904. (Agrost. 2394.)

13418. From Pistoja, Italy, 1904. (Agrost. 2395.)

13419. From Milan, Italy, 1904. (Agrost. 2398.)

13420. From Italy, 1904. (Agrost. 2399.)

13421. From Fabriano, Italy, 1904. (Agrost. 2400.)

13422. From Fabriano, Italy, 1904. (Agrost. 2402.)

13423. From Potenza, Italy, 1904. (Agrost. 2404.)

13424. From Macerata, Italy, 1904. (Agrost. 2405.)

13425. From Ancona, Italy, 1904. (Agrost. 2408.)

13426. From Ancona, Italy, 1904. (Agrost. 2409.)

13427. From Tursla, Italy, 1904. (Agrost. 2410.)

13428. From Parma, Italy, 1904. (Agrost. 2411.)

13429. From Perugia, Italy, 1904. (Agrost. 2413.)

13430. From Foggia, Italy, 1904. (Agrost. 2414.)

13431. From Italy, 1904. (Agrost. 2432.)

13432. VICIA UNIJUGA (?). **Vetch.**

From Japan, March 18, 1903. (Agrost. 1140.)

13433. VICIA VILLOSA. **Hairy vetch.**

From Argentine exhibit, Louisiana Purchase Exposition. (Agrost. 2317.)

13434. THEMEDA CILIATA.

From Palghar, Thana, India. Received thru Latham & Co., Bombay, India, January 20, 1904.

Bondani, a small kind of "Ful" grass. "One of the best sorts of grasses for grazing." (Agrost. 1787.)

13435. MEDICAGO SATIVA. **Alfalfa.**

Received from Henry Nungesser & Co., New York, N. Y., April 20, 1904.

Turkestan. (Agrost. 1957.)

13436. MEDICAGO SATIVA. **Alfalfa.**

Received from Steele, Briggs Seed Co., Toronto, Canada, December 8, 1904. (Agrost. 2131.)

13437. MEDICAGO SATIVA. **Alfalfa.**

Received from F. Barteldes & Co., Lawrence, Kans., 1904.

Arizona grown. (Agrost. 2518.)

13438. MEDICAGO SATIVA. **Alfalfa.**

Received from F. Barteldes & Co., Lawrence, Kans., 1904.

Minnesota grown. (Agrost. 2531.)

13439. MEDICAGO SATIVA. **Alfalfa.**

Kansas grown. (Agrost. 2530.)

13440. MEDICAGO SATIVA. **Alfalfa.**

Kansas grown. (Agrost. 2531).

13359 to 13556—Continued.

13441. AGROPYRON OCCIDENTALE.

From Hays, Kans. (Agrost. 1942.)

13442. AGROPYRON OCCIDENTALE.

From Harlem, Mont. (Agrost. 1982.)

13443. AGROPYRON OCCIDENTALE.

(Agrost. 1001.)

13444. BROMUS CARINATUS HOOKERIANUS.

From Seattle, Wash. (Agrost. 1887.)

13445. BROMUS CARINATUS HOOKERIANUS.

From Union, Oreg. (Agrost. 2097.)

13446. BROMUS INERMIS. **Smooth brome-grass.**

From Brandon, Mass. Received thru Brandon Seed House. (Agrost. 1996.)

13447. BROMUS MARGINATUS.

From Union, Oreg. (Agrost. 2091.)

13448. BROMUS POLYANTHUS PANICULATUS. (Agrost. 1177.)

13449. CALAMAGROSTIS HYPERBOREA. (Agrost. 841.)

13450. ELYMUS CONDENSATUS. **Giant rye-grass.**

From Union, Oreg. (Agrost. 2092.)

13451. ELYMUS TRITICOIDES. (Agrost. 2096.) **Wild wheat.**

13452. ELYMUS VIRGINICUS SUBMUTICUS.

From Union, Oreg. (Agrost. 1800.)

13453. FESTUCA PRATENSIS. **Meadow fescue.**

From Union, Oreg. (Agrost. 1799.)

13454 to 13477. VIGNA SINENSIS. **Cowpea.**

13454.

Early Black. Grown on Arlington Farm, 1904. Third generation from Agrost. 1233. From McCullough, March, 1902. (Agrost. 1233–3.)

13455.

Large Blackeye. Grown on Arlington Farm, 1904. Third generation from Agrost. 1224. From Alabama Experiment Station, March, 1902. (Agrost. 1224–3.)

13456.

Extra Early Blackeye. Grown on Arlington Farm, 1904. Third generation from Agrost. 1232. From Arkansas Station, March, 1902. Grown there for five years. (Agrost. 1232–3.)

13457.

California Blackeye. Grown on Arlington Farm, 1904. Third generation from Agrost. 1231. From Arkansas Station, March, 1904. (Agrost. 1231–3.)

13458.

Clay. Grown on Arlington Farm, 1904. Third generation from Agrost. 1255. From South Carolina Station, March, 1902. (Agrost. 1255–3.)

13459.

Clay. From T. W. Wood & Sons, April 2, 1904. (Agrost. 1937.)

13460.

Iron. Grown on Arlington Farm, 1904. Third generation from Agrost. 1247. From Mr. W. A. Orton, March, 1902. (Agrost. 1247–3.)

13359 to 13556—Continued.

13454 to 13477—Continued.

13461.

Iron. Grown by Mr. J. P. Dunlap, Dwight, Nebr., from seed of Congressional distribution, presumably from Monetta, S. C. Received from Mr. Dunlap, October, 1904. (Agrost. 2109.)

13462.

Iron. Received from Mr. S. M. Byrd, Cedartown, Ga., January 11, 1905. Grown in 1904 from seed of Congressional distribution, presumably from Monetta, S. C. (Agrost. 2136.)

13463.

Iron. Received from Mr. W. J. Edwards, Willshire, Ohio, March 6, 1905, and from Mr. J. A. Ritchie, Wapakoneta, Ohio, March 20, 1905. Grown from seed of Congressional distribution, presumably from Monetta, S. C. (Agrost. 2217.)

13464.

Iron. Received from four men in central Kentucky and southern Illinois, who grew it in 1904 from seed of Congressional distribution, presumably from Monetta, S. C. (Agrost. 2260.)

13465.

Iron. Received in March, 1905, from Mr. Han Abild, Wakonda, Clay County, S. Dak., who grew it in 1904 from seed of Congressional distribution, presumably from Monetta, S. C. (Agrost. 2310.)

13466.

Iron. Received from Mr. Charles G. Diament, Bridgeton, N. J., March 8, 1905. Grown from seed of Congressional distribution, presumably from Monetta, S. C. (Agrost. 2386.)

13467.

Iron. Received from G. C. Dulebohn, Kearney, Kans., March, 1905. Grown from seed of Congressional distribution, presumably from Monetta, S. C. (Agrost. 2387.)

13468.

Wonderful. Grown on Arlington Farm, 1904. From Texas Seed and Floral Company, Dallas, Tex., March, 1902. (Agrost. 1251–3.)

13469.

Wonderful. From T. W. Wood & Sons, Richmond, Va., April 2, 1904. (Agrost. 1938.)

13470.

Warren's Extra Early. Grown on Arlington Farm, 1904. Obtained in March, 1902, from Arkansas station, where it was grown for four years, and changed materially in size, color, and shape from the original seed procured from Maule, of Philadelphia. (Agrost. 1218–3.)

13471.

Warren's New Hybrid. Grown on Arlington Farm, 1904. From Louisiana station, March, 1902. (Agrost. 1288–3.)

13472.

Michigan Favorite. From Mr. E. E. Evans, Westbranch, Mich., May 13, 1904. (Agrost. 1991.)

13473.

Michigan Favorite. Grown on Arlington Farm, 1904. From Mr. E. E. Evans, Westbranch, Mich., May 13, 1904. (Agrost. 1991–1.)

13474.

Michigan Favorite. Received in March, 1905, from Mr. Han Abild, Wakonda, Clay County, S. Dak. Grown from seed of Congressional distribution, presumably from Monetta, S. C. (Agrost. 2309.)

13359 to 13556—Continued.

13454 to 13477—Continued.

13475.

Whippoorwill. Grown on Arlington Farm, 1904. From T. W. Wood & Sons, Richmond, Va., March, 1902. (Agrost. 1269–2.)

13476.

Taylor. Grown on Arlington Farm, 1904. From Alabama Station, March, 1902. (Agrost. 1248–3.)

13477.

New Era. Grown on Arlington Farm, 1904. From T. W. Wood & Sons, Richmond, Va., April 2, 1904. (Agrost. 1936–1.)

13478 to 13487. Medicago sativa. **Alfalfa.**

13478.

Received from F. Barteldes & Co., Lawrence, Kans., April 22, 1904. (Agrost. 1968.)

13479.

Grown in Arizona. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1904. (Agrost. 1958.)

13480.

Grown in Meade County, Kans. Received from F. Barteldes & Co., Lawrence, Kans., April 22, 1904. (Agrost. 1970.)

13481.

Grown in Italy. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1906. (Agrost. 1956.)

13482.

Grown in France. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1904. (Agrost. 1955.)

13483.

Grown in Utah. Received from C. A. Smurthwaite Produce Company, Ogden, Utah, April 25, 1904. (Agrost. 1983.)

13484.

Grown in Colorado. Received from F. Barteldes & Co., Lawrence, Kans., April 20, 1904. (Agrost. 1967.)

13485.

Grown in Kansas. Received from F. Barteldes & Co., Lawrence, Kans., April 20, 1904. (Agrost. 1969.)

13486.

Grown in Utah. (Agrost. 2532.)

13487.

Grown in Texas. (Agrost. 2533.)

13488. Medicago media. **Sand lucern.**

Grown in Wisconsin. (Agrost. 2534.)

13489. Medicago sativa. **Alfalfa.**

Grown in Wyoming. Received from the A. Dickinson Company, Chicago, Ill., 1903. (Agrost. 1885.)

13490. Trifolium pratense. **Red clover.**

Received from T. W. Wood & Sons, Richmond, Va., April 18, 1904. (Agrost. 1952.)

13359 to 13556—Continued.

13491. TRIFOLIUM INCARNATUM. **Crimson clover.**

White Blooming. Received from T. W. Wood & Son, Richmond, Va., April 18, 1904. (Agrost. 1953.)

13492. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown in Moravia. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1904. (Agrost. 1964.)

13493. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown in France. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1904. (Agrost. 1961.)

13494. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown in Italy. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1904. (Agrost. 1962.)

13495. TRIFOLIUM PRATENSE. **Red clover.**

Received from F. Barteldes & Co., Lawrence, Kans., April 22, 1904. (Agrost. 1955.)

13496. TRIFOLIUM PRATENSE. **Red clover.**

Grown in Barry County, Mo. Received from F. Barteldes & Co., Lawrence, Kans., April 22, 1904. (Agrost. 1966.)

13497. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown in England. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1903. (Agrost. 1963.)

13498. TRIFOLIUM PRATENSE. **Red clover.**

Grown in Russia. Received from Henry Nungesser & Co., New York, N. Y., April 20, 1903. (Agrost. 1960.)

13499. TRIFOLIUM PRATENSE. **Red clover.**

Received from T. W. Wood & Sons, Richmond, Va., February 19, 1903. (Agrost. 1113.)

13500. TRIFOLIUM ALEXANDRINUM. **Berseem.**

Grown in Egypt. Received from Henry Nungesser & Co , New York, N. Y., April 20, 1904. (Agrost. 1959.)

13501. TRIFOLIUM HYBRIDUM. **Alsike.**

(Agrost. 891.)

13502. GLYCINE HISPIDA. **Soy bean.**

Ogema. Received from Mr. Edward E. Evans, West Branch, Mich., May, 1904. (Agrost. 1992.)

13503. GLYCINE HISPIDA. **Soy bean.**

Grown at Arlington Farm, 1904. (Agrost. 912–3.)

13504. AGROPYRON OCCIDENTALE.

Received from Thomas Everett, Harlem, Mont., April, 1905.

13505. BROMUS MARGINATUS.

Collected by Mr. J. S. Cotton, in the Wenache Mountains, Washington, in 1904. (Agrost. 2098.)

13506. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Gap, French Alps, France. (Agrost. 2218.)

13507. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Mysoke, Myto, Bohemia. (Agrost. 2219.)

13508. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Neu Bydzow, Bohemia. (Agrost. 2220.)

13359 to 13556—Continued.

13509. TRIFOLIUM PRATENSE. **Red clover.**

Zelenac. Grown at Neu Bydzow, Bohemia. (Agrost. 2221.)

13510. TRIFOLIUM HYBRIDUM. **Alsike.**

Grown at Neu Bydzow, Bohemia. (Agrost. 2222.)

13511. TRIFOLIUM REPENS. **White clover**

Grown at Alt Bydzow, Bohemia. (Agrost. 2223.)

13512. TRIFOLIUM REPENS. **White clover.**

Grown at Podolia, Russia. (Agrost. 2224.)

13513. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Goteborg, Sweden. (Agrost. 2225.)

13514. TRIFOLIUM HYBRIDUM. **Alsike.**

Grown at Goteborg, Sweden. (Agrost. 2226.)

13515. TRIFOLIUM PRATENSE. **Red clover.**

Grown in Chile. (Agrost. 2227.)

13516. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Gelderland, Holland. (Agrost. 2228.)

13517. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Brabant, Holland. (Agrost. 2229.)

13518. TRIFOLIUM REPENS. **White clover.**

Grown near Arnheim, Holland. (Agrost. 2230.)

13519. MEDICAGO SATIVA. **Alfalfa.**

Grown at Saragossa, Spain. (Agrost. 2231.)

13520. MEDICAGO SATIVA. **Alfalfa.**

Grown at Pfalz, Palatinate, Germany. (Agrost. 2232.)

13521. MEDICAGO SATIVA. **Alfalfa.**

Grown in Oran Province, Algeria. (Agrost. 2233.)

13522. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Toulouse, Garonne, France. (Agrost. 2234.)

13523. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Charente-Inferieure, Poitou, France. (Agrost. 2235.)

13524. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Nantes, Anjou, France. (Agrost. 2236.)

13525. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Troyes, Champagne, France. (Agrost. 2237.)

13526. TRIFOLIUM PRATENSE. **Red clover.**

Grown at St. Malo, Bretagne, France. (Agrost. 2238.)

13527. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Albeville, Picardy, France. (Agrost. 2239.)

13528. TRIFOLIUM ALEXANDRINUM. **Berseem.**

Grown at Alexandria, Egypt. (Agrost. 2240.)

13529. TRIFOLIUM REPENS. **White clover.**

Grown at Milan, Lodi, Italy. (Agrost. 2241.)

13530. TRIFOLIUM REPENS. **White clover.**

Grown at Lorraine, France. (Agrost. 2242.)

13359 to 13556—Continued.

13531. TRIFOLIUM REPENS. **White clover.**

Grown at Lorraine, France. (Agrost. 2243.)

13532. TRIFOLIUM FILIFORME.

Grown at Poitiers, France. (Agrost. 2244.)

13533. TRIFOLIUM FRAGIFERUM.

Grown at Paris, France. (Agrost. 2245.)

13534. TRIFOLIUM HYBRIDUM. **Alsike.**

Grown at Beauce, France. (Agrost. 2246.)

13535. TRIFOLIUM HYBRIDUM. **Alsike.**

Grown at Champagne, France. (Agrost. 2247.)

13536. TRIFOLIUM PANNONICUM. **Hungarian clover.**

Grown at Paris, France. (Agrost. 2248.)

13537. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown at Poitou, France. (Agrost. 2249.)

13538. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown at Beauce, France. (Agrost. 2250.)

13539. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown at Beauce, France. (Agrost. 2251.)

13540. TRIFOLIUM INCARNATUM. **Crimson clover.**

Grown at Beauce, France. (Agrost. 2252.)

13541. MEDICAGO SATIVA. **Alfalfa.**

Grown at Gard, France. (Agrost. 2253.)

13542. MEDICAGO SATIVA. **Alfalfa.**

Grown at Orange, Provence, France. (Agrost. 2254.)

13543. MEDICAGO SATIVA. **Alfalfa.**

Grown at Charente, Poitou, France. (Agrost. 2255.)

13544. MEDICAGO SATIVA. **Alfalfa.**

Grown at Anjou, Pays, France. (Agrost. 2256.)

13545. MEDICAGO SATIVA. **Alfalfa.**

Grown at Nord, France. (Agrost. 2257.)

13546. MEDICAGO SATIVA. **Alfalfa.**

From Turkestan, Asia. (Agrost. 2258.)

13547. MEDICAGO SATIVA. **Alfalfa.**

Grown at Bologna, Italy. (Agrost. 2525.)

13548. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Warwickshire, England. (Agrost. 2526.)

13549. TRIFOLIUM PRATENSE. **Red clover.**

Grown at Hampshire, England. (Agrost. 2527.)

13550. TRIFOLIUM REPENS. **White clover.**

Grown at Norfolkshire, England. (Agrost. 2528.)

13551. TRIFOLIUM HYBRIDUM. **Alsike.**

Grown at Cambridge, England. (Agrost. 2529.)

13552. MEDICAGO DENTICULATA. **Bur clover.**

From T. W. Wood & Sons, Richmond, Va., March 16, 1903. (Agrost. 1129.)

13359 to 13556—Continued.

13553. Atriplex bracteosa.

From Phoenix, Ariz. Collected by Dr. D. Griffiths, October 16, 1903. (Agrost. 1824.)

13554. Atriplex bracteosa.

From Tucson, Ariz. Collected by Dr. D. Griffiths, October 11, 1903. (Agrost. 1825.)

13555. Atriplex bracteosa.

From San Rita Mountains, Arizona. Collected by Dr. D. Griffiths, October 10, 1903. (Agrost. 1826.)

13556. Atriplex confertifolia.

Collected by Dr. D. Griffiths, 1903. From valley of the Little Colorado, Arizona. (Agrost. 1828.)

13557. Atriplex bracteosa.

From Santa Rita Mountains, Arizona. Collected by Dr. D. Griffiths, May 23, 1903. (Agrost. 1827.)

13558. Melilotus sulcata.

From Algeria, October, 1903. (Agrost. 1161.)

13559. Melilotus speciosa.

From Shao-king, Chehkiang Province, China. Received February 12, 1904. Presented by Mr. Cyril E. Bomfield.

"The Chinese mainly use its heavy, rank growth for fertilizing the soil previous to sowing rice." (Agrost. 1866.)

13560. Trifolium longipes. **Mountain clover.**

From Wenache Mountains, Washington, at altitude of 5,000 feet. Collected by Mr. J. S. Cotton, October, 1904. (Agrost. 2108.)

13561. Medicago sativa. **Alfalfa.**

From A. LeCoq & Co., Darmstadt, Germany, March 28, 1903.
Turkestan. (Agrost. 2208.)

13562. Hordeum bulbosum.

Received June 28, 1904. (Agrost. 263.)

13563. Panicum maximum. **Guinea grass.**

From Barbados, West Indies.

13564. Medicago sativa. **Alfalfa.**

From Mollendo, Peru. Collected by Mr. Enrique Meier in 1903. (Agrost. 2168.)

13565. Andropogon sorghum. **Milo maize.**

Purchased from Mr. W. W. Hutchens, Chillicothe, Tex., in the autumn of 1904. (Agrost. 2090.)

13566. Bouteloua curtipendula. **Side oats.**

Received from Mr. James K. Metcalfe, Silver City, N. Mex., February 26, 1904. (Agrost. 1889.)

13567. Olea europaea. **Olive.**

From Tunis, North Africa. Received from Mr. Louis Fidelle, thru Mr. T. H. Kearney, April 20, 1905.

Chemlali. "This is an olive with very small fruit, very rich in oil, and a heavy yielder, adapted to the driest, hottest region known in which olive culture flourishes, the rainfall at Sfax, in southern Tunis, where it is the only variety grown extensively, averaging about 10 inches yearly, and sometimes falling to 5 or 6 inches as the average for several successive years. Notwithstanding this small rainfall, the orchards are never irrigated at Sfax except during the first two or three summers after planting. In some orchards the cuttings are irrigated only a single time, receiving about 6 gallons each. Extraordinary precautions are taken to preserve the soil moisture near the surface, the olive being a shallow-rooting tree. The trees are planted from 65 to 80 feet apart each way, the wider planting giving seven trees per acre. The ground between is kept entirely clean, not even grain crops being grown after the tree begins to bear. The surface of the soil is always kept in a well-pulverized condition to reduce evaporation. Three or four plowings a year are given, and as many cultivations as are necessary to keep out weeds. Manuring is practised only to a very limited extent. The orchards at Sfax are always created with pieces of wood from the base of very old trees, such as those sent you. The cuttings are generally set out in the fall (but sometimes in the spring) in the bottom of holes that are 2 feet deep and 2 feet square. These are filled up as the tree grows, until in about two years they are entirely filled. It is often the practise to keep a shallow basin, 6 inches or so deep, around the base of the tree during the rainy season (winter), the diameter of the basin being about equal to that of the spread of the foliage. In summer the ground is plowed up to the bases of the trees. The soil around Sfax is a reddish sandy loam to a depth of 2 or 3 feet or more, below which hardpan is often encountered.

"The trees are pruned during the harvest every other year, beginning when 3 years old. The average yields obtained at Sfax from trees respectively 10, 15, 20, and 25 years old appear to be about 2, 6, 10, and 12½ quarts of oil per tree. In good years twice as much is obtained. The percentage of oil in the fruit, as well as the quantity of fruit produced, increases rapidly as the tree grows older." (*Kearney.*)

13568. MUSA SAPIENTUM. **Banana.**

From Gabes, Tunis, North Africa. Received thru Mr. T. H. Kearney, April 20, 1905.

13569. PISTACIA VERA. **Pistache.**

From Caltanisetta, Sicily. Received thru Mr. T. H. Kearney, from Signor Deleo, April 20, 1904.

Trabonella.

13570. ZEA MAYS. **Sweet corn.**

From Riverside Farm, Nashua, N. H. Received April 17, 1905.

Crosby. Said to be the result of eighteen years' selection.

13571. NEPHELIUM LAPPACEUM. **Rambutan.**

From Buitenzorg, Java. Received thru Doctor Treub, April 22, 1905.

Native of south India and Malay Islands, and furnishes a fruit similar to the Litchi, namely, the Rambutan or Ramboostan fruit. All species of Nephelium seem to require rather a moist, mild, forest clime than great atmospheric heat.

The fruit is of a bright-red color, about 2 inches long, of an oval form, and slightly flattened, and covered with long, soft, fleshy spines or thick hairs. Like the other Nepheliums it contains a pleasant acidulous pulp very grateful in tropical countries.

13572. GARCINIA MANGOSTANA. **Mangosteen.**

From Buitenzorg, Java. Received thru Doctor Treub, April 17, 1905.

13573. JUGLANS REGIA. **Persian walnut.**

From Kashgar, eastern Turkestan, Asia. Presented by Rev. P. J. P. Hendriks. Received April 11, 1905.

13574. GLYCYRRHIZA GLABRA. **Licorice.**

From London, England. Received thru Messrs. Barr & Sons, April 17, 1905.

13575. ALTHAEA ROSEA. **Hollyhock.**

From New York, N. Y. Received from Henry & Lee, importers, March, 1905.

Japanese.

13576 to 13582.

From Christiania, Norway. Presented by Mr. C. Doxrud, thru Miss Carrie Harrison, of this Department. Received April 13, 1905.

13576. AVENA SATIVA. **Oat.**

White. Cultivated in 1898 under the Arctic Circle.

13577. AVENA SATIVA. **Oat.**

Black. Cultivated at northern latitude of 64°.

13578. HORDEUM VULGARE (?). **Barley.**

Cultivated in 1898 under the Arctic Circle.

13579. PISUM SATIVUM. **Pea.**

Cultivated at northern latitude of 63½°.

13580. PHLEUM PRATENSE. **Timothy.**

Cultivated at northern latitude of 63½°.

13581. TRIFOLIUM PRATENSE. **Red clover.**

Cultivated at northern latitude of 63½°.

13582. VICIA sp. **Vetch.**

Cultivated at northern latitude of 63½°.

"We are informed that these seeds have been collected within the Arctic Circle, and it is probable that they represent very short-seasoned types, which are likely to be of unusual value in northern Alaska and possibly in portions of our Northern States." (*Fairchild.*)

13583 to 13585. GOSSYPIUM sp. **Cotton.**

From Peru. Received thru W. R. Grace & Co., New York, N. Y., April 19, 1905.

13583. *Vitarte.*

Smooth cotton seed from Vitarte; represents the seed of cotton grown in the valleys of Peru. This cotton is similar to Egyptian and is known as "*Egypto*" cotton. It is used by the various cotton mills in this country in the manufacture of "domestics." The surplus is shipped to Liverpool, where it finds a market at a price a little over American cotton, say 0.40d. per pound. There is one crop of this cotton every year, the same as with American cotton. The seed is planted in September or October and the cotton is gathered in May or August the following year. The annual crop is about 7,500,000 pounds.

13584. *Palpa.* **13585.** *Nazca.*

Palpa, *Nazca*, and *Ica* (No. 14801) represent seed of Peruvian cotton grown in these different places, which are in the southern part of Peru. Here the crop is twice a year, same seasons as the "Full rough." Crop varies from 6,000 bales (of 100 pounds) in a dry year to 15,000 bales in a good year. The cotton seed of the "Full rough" (No. 12938) and "Moderate rough" (*Palpa*, *Nazca*, and *Ica*) is exported to England, while the seed of the "*Egypto*" is prest here and the cotton-seed cake, known as "Pasta," is shipped to Liverpool. The oil is sold here chiefly for use in mines, and portions of it as Italian salad oil.

13586. PHALARIS CANARIENSIS. **Canary grass.**

From Patras, Greece. Presented by Mr. S. Xanthopoulo, of the Station Agricole. Received April 19, 1905.

In his letter of April 1, Mr. Xanthopoulo stated that this seed was procured by him from Turkey.

13587 to 13599.

From Chelsea, England. Received thru James Veitch & Sons, March 28, 1905.

Flower seeds.

13600 to 13620.

From Reading, England. Received thru Sutton & Sons, about March 3, 1905.

Flower seeds.

13621 and 13622. **Matting rush.**

From Tokyo, Japan. Presented by Prof. J. Matsumura, Imperial University. Received April 24, 1905.

13621. JUNCUS EFFUSUS DECIPIENS.

13622. JUNCUS SETCHUENSIS EFFUSOIDES.

13623 to 13636.

From London, England. Received thru Barr & Sons, Covent Garden, March 8, 1905.

Flower seeds.

13637 to 13647.

From New York, N. Y. Received thru J. M. Thorburn & Co., about February 17, 1905.

Flowering perennials.

13648. MEDICAGO CANCELLATA.

From Rostoff on Don, Russia. Received from Mr. George R. Martin, thru the American consular agency, September 21, 1905.

13649 to 13663.

From Erfurt, Germany. Received thru Mr. Ernst Benary, March 16, 1905.

Flower seeds.

13664 to 13693.

From Paris, France. Received thru Vilmorin-Andrieux & Co., March 3, 1905.

Flower seeds.

13694 and 13695.

From Marblehead, Mass. Received thru James J. H. Gregory & Son, February 27, 1905.

Flower seeds.

13696 to 13698.

From Philadelphia, Pa. Received thru Henry A. Dreer, Incorporated, in the spring of 1905.

Flower seeds.

13699 to 13703.

From Naples, Italy. Received thru Mr. Max Herb, in the spring of 1905.

Flower seeds.

13704. RUDBECKIA SPECIOSA BICOLOR.

From Philadelphia, Pa. Received thru W. A. Burpee & Co., February 17, 1905.

13705 to 13707.

From Boston, Mass. Received thru W. W. Rawson & Co., 12 Faneuil Hall Square, about February 15, 1905.

Flower seeds.

13708 to 13711.

From Boston, Mass. Received thru R. & J. Farquhar & Co., in January, 1905.

Flower seeds.

13712 to 13714.

From Ottawa, Ontario, Canada. Presented by Mr. J. B. Lewis, C. E., 126 Sparks street. Received February 21, 1905.

Flower seeds.

13715 to 13718.

From Erfurt, Germany. Received thru Mr. F. C. Heinemann, in the spring of 1905.

Flower seeds.

13719 to 13721.

From Erfurt, Germany. Received thru Haage & Schmidt, in the spring of 1905.

Flower seeds.

13722 and 13723. Aquilegia sp. **Columbine.**

From Wordsley, Stourbridge, England. Received thru Webb & Sons, in the spring of 1905.

13724. Papaver orientale hyb. **Poppy.**

From Boston, England. Received thru W. W. Johnson & Co., March 7, 1905.

13725 to 13727.

(Origin and date of receipt uncertain.)

Flower seeds.

13728. Lansium domesticum. **Doekoe.**

From Buitenzorg, Java. Presented by Doctor Treub. Received April 29 and May 4, 1905.

13729 to 13731. Persea gratissima. **Avocado.**

From Miami, Fla. Presented by Mr. George B. Cellon to the Subtropical Laboratory thru Mr. S. B. Bliss. Received April 12, 1905.

13729. *Baldwin.*

13730. *Haden.*

13731. *Rico.*

13732. Moraea iridioides.

From Cape Town, South Africa. Presented by Prof. P. MacOwan, Department of Agriculture. Received April 24, 1905.

A native South African plant, growing 2½ feet high; flowers iris-like.

13733 to 13794.

Seeds transferred from the Office of Grass and Forage Plant Investigations to the Office of Seed and Plant Introduction and Distribution, May 1, 1905.

13733 to 13771.

From the Louisiana Purchase Exposition.

13733. Brassica napus. **Rape.**

From Milan, Italy. (Agrost. 2476.)

13733 to 13794—Continued.

13733 to 13771—Continued.

13734. Trifolium pratense. Red clover.

From Voghera, Italy. (Agrost. 2477.)

13735. Trifolium pratense. Red clover.

From Padova, Italy. (Agrost. 2478.)

13736. Trifolium pratense. Red clover.

From Asti, Italy. (Agrost. 2479.)

13737. Trifolium pratense. Red clover.

From Lodi, Italy. (Agrost. 2480.)

13738. Medicago sativa. Alfalfa.

From Milan, Italy. (Agrost. 2481.)

13739. Medicago sativa. Alfalfa.

From Padova, Italy. (Agrost. 2482.)

13740. Trifolium pratense. Red clover.

From Lorino, Italy. (Agrost. 2483.)

13741. Trifolium pratense. Red clover.

From Aguila, Italy. (Agrost. 2484.)

13742. Medicago lupulina. Yellow trefoil.

From Como, Italy. (Agrost. 2485.)

13743. Medicago sativa. Alfalfa.

From Treviso, Italy. (Agrost. 2486.)

13744. Medicago sativa. Alfalfa.

From Parma, Italy. (Agrost. 2487.)

13745. Medicago sativa. Alfalfa.

From Triora, Italy. (Agrost. 2488.)

13746. Trifolium pratense. Red clover.

From Triora, Italy. (Agrost. 2489.)

13747. Trifolium pratense. Red clover.

From Verona, Italy. (Agrost. 2490.)

13748. Trifolium pratense. Red clover.

From Pesaro, Italy. (Agrost. 2491.)

13749. Trifolium pratense. Red clover.

From Pairo, Italy. (Agrost. 2492.)

13750. Lotus corniculatus. Bird's-foot trefoil.

From Genoa, Italy. (Agrost. 2493.)

13751. Medicago lupulina. Yellow trefoil.

From Treviso, Italy. (Agrost. 2494.)

13752. Trifolium pratense. Red clover.

From Ferrara, Italy. (Agrost. 2495.)

13753. Medicago sativa. Alfalfa.

From Pisa, Italy. (Agrost. 2496.)

13754. Medicago sativa. Alfalfa.

From Triora, Italy. (Agrost. 2497.)

13755. Medicago sativa. Alfalfa.

From Verona, Italy. (Agrost. 2498.)

13733 to 13794—Continued.

13733 to 13771—Continued.

13756. Trifolium pratense. **Red clover.**

From Treviso, Italy. (Agrost. 2499.)

13757. Medicago sativa. **Alfalfa.**

From Milan, Italy. (Agrost. 2500.)

13758. Medicago sativa. **Alfalfa.**

From Voghera, Italy. (Agrost. 2501.)

13759. Medicago sativa. **Alfalfa.**

From Ales, Italy. (Agrost. 2502.)

13760. Trifolium pratense. **Red clover.**

(No label.) (Agrost. 2503.)

13761. Trifolium pratense. **Red clover.**

(No label.) (Agrost. 2504.)

13762. Medicago denticulata. **Bur clover.**

From Argentina. (Agrost. 2505.)

13763. Trifolium pratense. **Red clover.**

From Argentina. (Agrost. 2506.)

13764. Trifolium incarnatum. **Crimson clover.**

From Argentina. (Agrost. 2507.)

13765. Trifolium hybridum. **Alsike.**

From Argentina. (Agrost. 2508.)

13766. Trifolium pratense. **Red clover.**

From Argentina. (Agrost. 2509.)

13767. Medicago sativa. **Alfalfa.**

From Argentina. (Agrost. 2510.)

13768. Medicago sativa. **Alfalfa.**

From Argentina. (Agrost. 2511.)

13769. Medicago sativa. **Alfalfa.**

From Argentina. (Agrost. 2512.)

13770. Trifolium pratense. **Red clover.**

From Treviso, Italy. (Agrost. 2513.)

13771. Trifolium pratense. **Red clover.**

From Italy. (Agrost. 2514.)

13772 to 13775.

From Reading, England. Received from Sutton & Sons, March, 1903.

13772. Trifolium pratense perenne. **Red clover.**

(Agrost. 2156.)

13773. Trifolium repens perenne. **White clover.**

(Agrost. 2157.)

13774. Trifolium pratense. **Red clover.**

(Agrost. 2158.)

13775. Trifolium hybridum. **Alsike.**

Sutton's giant hybrid cow clover. (Agrost. 2159.)

13776. Trifolium pratense. **Red clover.**

From Reading, England, March 20, 1903. (Agrost. 2162.)

13733 to 13794—Continued.

13777. TRIFOLIUM REPENS. **Wild white clover.**

From Dickson, Chester, England, May 5, 1903. (Agrost. 2179.)

13778. MEDICAGO SATIVA. **Alfalfa.**

From Missouri Seed Company, 1903. (Agrost. 2180.)

13779. VICIA FABA. **Broad bean.**

From Naples, Italy. Collected for World's Fair. (Agrost. 2417.)

13780. VICIA FABA. **Broad bean.**

From Italy, 1904. (Agrost. 2418.)

13781. VICIA FABA. **Broad bean.**

From Caserta, Italy, 1904. Collected for World's Fair. (Agrost. 2419.)

13782. VICIA FABA. **Broad bean.**

From Caserta, Italy, 1904. Collected for World's Fair. (Agrost. 2420.)

13783. VICIA FABA. **Broad bean.**

From Italy, 1904. (Agrost. 2421.)

13784. VICIA FABA. **Horse bean.**

From Caserta, Italy, 1904. Collected for World's Fair. (Agrost. 2422.)

13785. VICIA FABA. **Horse bean.**

From Rome, Italy, 1904. Collected for World's Fair. (Agrost. 2423.)

13786. (Unidentified legume.) (Agrost. 2464.)

13787 to 13793. BRASSICA NAPUS. **Rape.**

From the Louisiana Purchase Exposition. European varieties.

13787. (Agrost. 2467.)
13788. (Agrost. 2468.)
13789. (Agrost. 2469.)
13790. (Agrost. 2470.)
13791. (Agrost. 2471.)
13792. (Agrost. 2472.)
13793. (Agrost. 2473.)

13794. ONOBRYCHIS ONOBRYCHIS. **Sainfoin.**

From Argentina. (Agros. 2475.)

13795. BROMUS INERMIS. **Smooth brome-grass.**

From Pueblo, Colo. Received thru Keen Bros., April, 1905.

This seed is from a good crop grown under conditions of unusual drought and high temperature. It may therefore be valuable in extending the range of this plant farther south.

13796. VICIA ANGUSTIFOLIA (?). **Vetch.**

From Augusta, Ga. Received thru the N. L. Willet Drug Company, April, 1905.

Said to be the most valuable vetch grown in the vicinity of Augusta, Ga.

13797. LOLIUM BONAERENSIS.

From Argentina. Received from Argentine exhibit, Louisiana Purchase Exposition, spring of 1905.

13798 to 13800.

From Buitenzorg, Java. Presented by Doctor Treub. Received May 4, 1905.

13798. NEPHELIUM LAPPACEUM. **Rambutan.**

13799. NEPHELIUM MUTABILE. **Kapoelasan.**

13800. GARCINIA MANGOSTANA. **Mangosteen.**

13801 and 13802.

From London, England. Received thru James Veitch & Son, April 21, 1905.

13801. ACER MYABEI.

13802. MAGNOLIA STELLATA ROSEA.

13803. AGAPANTHUS UMBELLATUS.

From Berlin, Germany. Received thru L. Spath in 1902.

13804. (Undetermined.)

From Argentina. Received thru Dr. B. T. Galloway in 1902.

Seeds of a tree probably belonging to the family Myrtaceae.

13805. HESPERALOË FUNIFERA.

From Cerritos, Mexico. Received August, 1903. Grown under G. & G. No. 3995 and numbered in May, 1905.

"While the plant is used to a considerable extent for the production of fiber in Mexico, I think it is doubtful whether it could be used for this purpose profitably in this country with our present facilities for cleaning fiber. It is a rather striking ornamental plant, with its large open panicle of pinkish or purplish flowers, followed by pear-shaped, dark-purple seed pods. I would recommend it especially for planting in dry situations in parks and in the Southern States. In the northern part of its range in Mexico it must endure winter temperatures down to zero, and if planted in well-drained soils and protected by a mulch in winter, it will doubtless survive out of doors in the parks of the Southern States." (*Dewey.*)

13806. PSIDIUM GUAJAVA POMIFERUM. **Guava.**

From Argentina. Received thru Dr. B. T. Galloway in 1902. Grown under G. & G. No. 358 and numbered in May, 1905.

13807. HIPPEASTRUM hyb.

From Washington, D. C. Numbered May 7, 1905.

A seedling with double flowers, produced by Mr. G. W. Oliver by crossing.

13808. CINNAMOMUM CAMPHORA. **Camphor.**

From Huntington, Fla. Collected by Mr. W. O. Richtmann, of Drug and Medicinal Plant Investigations, from a tree on the grounds of Dr. George E. Walker, April, 1905.

13809 to 13818.

From Laguna, Cal. Collected by Dr. B. T. Galloway, in the vicinity of Laguna, and sent to Mr. G. W. Oliver for use in breeding. Received May 7, 1905.

13809. MEDICAGO sp.

13810. TRIFOLIUM sp.

13811. LESPEDEZA JAPONICA.

13812. AVENA sp. **Oat.**

"Thousands of acres of this wild oat are being harvested for hay. Good thing for hybridizing. Grown on soil with 10 inches of rain. Cuts 4 to 5 tons per acre." (*Galloway.*)

13813. (Undetermined.) **Grass.**

13814. (Undetermined.) **Grass.**

13815. (Undetermined.) **Grass.**

13816. ECHINOCYSTIS sp. (No. 1.)

13817. ECHINOCYSTIS sp. (No. 2.)

13818. BLOOMERIA AUREA.

13819 to 13851. Diospyros kaki. **Japanese persimmon.**

A collection of plants of named varieties secured for the use of Mr. G. W. Oliver in breeding work. Received in January, 1905.

13819 to 13820.

Received thru the P. J. Berckmans Company, Augusta, Ga.

13819. *Maru gata.*
13820. *Miye tan.*

13821 to 13825.

Received thru the Fancher Creek Nurseries, Fresno, Cal.

13821. *Dai-dai maru.*
13822. *Goshi gaki.*
13823. *Hachiya.*
13824. *Tsuro noko.*
13825. *Yemon.*

13826 to 13834.

Received thru Mr. G. L. Taber, Glen St. Mary, Fla.

13826. *Costata.*
13827. *Okame.*
13828. *Taber's No. 23.*
13829. *Taber's No. 129.*
13830. *Tane nashi.*
13831. *Triumph.*
13832. *Tsuru.*
13833. *Yeddo ichi.*
13834. *Zengi.*

13835 to 13851.

Received thru the Yokohama Nursery Company, Yokohama, Japan.

13835. *Dai-dai maru.*
13836. *Daitsurumoko.*
13837. *Giboshi.*
13838. *Gosho.*
13839. *Hachiya.*
13840. *Kozuru.*
13841. *Kuro kuma.*
13842. *Mamegaki.*
13843. *Minozuru.*
13844. *Mushirazu.*
13845. *Mizigaki.*
13846. *Shakumi.*
13847. *Shibuyemon.*
13848. *Tane nashi.*
13849. *Zenji maru.*
13850. (Unnamed.)
13851. (Unnamed.)

13852. Cephalaria tatarica.

From New York, N. Y. Received thru J. M. Thorburn & Co., May 5, 1905.

13853. Trifolium repens. **White clover.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., May 6, 1905.

White Lodino. "This is a giant form of white clover from the Po Valley, truly perennial, hardy, tall (2 feet), recovering more quickly than other clovers after cutting. Not adapted to light, sandy, or poor soil, but gives 3 to 4 cuttings; 4 to 5 tons of hay on rich soil." (*Vilmorin-Andrieux & Co.*)

13854 to 13856. Triticum durum. **Macaroni wheat.**

From North Platte, Nebr. Received April 29, 1905.

Macaroni wheats grown by the Nebraska Experiment Station from imported seed.

13854. *Yellow Gharnovka.*
13855. *Black Don.*
13856. *Velvet Don.*

13857 and 13858. Medicago sativa. **Alfalfa.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., May 8, 1905.

13857. From Simbirsk, Russia.
13858. From Kharkof, Russia.

13859. Allium cepa. **Onion.**

From Paris, France. Presented by Vilmorin-Andrieux & Co. Received May 6, 1905.

Sainte Marie. "This onion is remarkable for its great earliness. It is flat in shape, with a very fine neck, and produces, as quickly as the *White Queen* onion, marketable bulbs of a larger size than those of the latter. It seems to us that it might be a desirable variety for truck farmers in the Southern States." (*Vilmorin-Andrieux & Co.*)

13860. Stipa tenacissima. **Esparto grass.**

From Office of Grass and Forage Plant Investigations. Received May 9, 1905. Originally from J. M. Thorburn & Co., New York, N. Y. (Agrost. No. 2216.)

13861. Nephelium mutabile. **Kapoelasan.**

From Buitenzorg, Java. Presented by Doctor Treub. Received May 12, 1905.

13862. Clitoria ternatea (?) **Butterfly pea.**

From Porto Rico. Grown from seed presented by the Governor. Plants numbered May 6, 1905.

13863. Clematis davidiana. **Clematis.**

From Philadelphia, Pa. Received thru Henry A. Dreer, Incorporated, May 6, 1905.

13864. Hydrastis canadensis. **Golden-seal.**

From Mantua, Ohio. Received thru Mr. A. W. Russel, at the request of Mr. W. W. Stockberger, May 15, 1905. Seed for use in connection with experiments being carried on by Dr. R. H. True.

13865 to 13924.

From Pretoria, South Africa. Presented by Mr. G. Baylis, Division of Botany, Transvaal Department of Agriculture, thru Prof. W. J. Spillman. Received May 1, 1905.

A collection of native grass seeds as follows (the numbers in parentheses are Mr. Baylis's):

13865. (Natal redtop.) (239/05.)

13866. (Native grass.) (240/05.)

13867. Eragrostis sp. (241/05.)

13868. Eragrostis sp. (242/05.)

13869. (Native grass.) (243/05.)

13870. (Native grass.) (244/05.)

13871. Eragrostis chloromelas. (245/05.)

13872. (Native grass.) (247/05.)

13873. Andropogon contortus. (248/05.)

13874. (Native grass.) (249/05.)

13875. Eragrostis sp. (250/05.)

13876. Eragrostis sp. (251/05.)

13877. Agrostis sp. (252/05.)

13878. Capriola dactylon (253/05.)

13879. Aristida sp. (254/05.)

13880. Andropogon sp. (255/05.)

13881. Elionurus argentenus. (256/05.)

13882. Andropogon sp. (257/05.)

13883. Eragrostis plana. (258/05.)

13884. Eragrostis lappula divaricula. (259/05.)

13885. Eragrostis sp. (260/05.)

13865 to 13924—Continued.

13886. Arundinella ecklonii. (261/05.)

13887. Chaetochloa sp. (262/05.)

13888. (Native grass.) (263/05.)

13889. Andropogon eucomus. (264/05.)

13890. (Native grass.) (265/05.)

13891. (Native grass.) (277/05.)

13892. Aristida sp. (278/05.)

13893. Tricholaena rosea. (279/05.)

13894. Panicum colonum. (281/05.)

13895. Chloris virgata. (282/05.)

13896. Eragrostis sp. (285/05.)

13897. Eragrostis sp. (286/05.)

13898. (Native grass.) (287/05.)

13899. Aristida sp. (288/05.)

13900. Eragrostis sp. (289/05.)

13901. Chloris virgata. (290/05.)

13902. (Native grass.) (291/05.)

13903. (Native grass.) (292/05.)

13904. Eragrostis sp. (293/05.)

13905. (Native grass.) (294/05.)

13906. Eragrostis sp. (295/05.)

13907. (Native grass.) (296/05.)

13908. (Native grass.) (297/05.)

13909. (Native grass.) (298/05.)

13910. Chaetochloa aurea. (299/05.)

13911. Chaetochloa sp. (300/05.)

13912. Chaetochloa nigrirostre (?) (301/05.)

13913. Panicum isachne. (302/05.)

13914. Chaetochloa pennisetum (?) (303/05.)

13915. (Native grass.) (305/05.)

13916. (Native grass.) (306/05.)

13917. (Native grass.) (307/05.)

13918. (Native grass.) (308/05.)

13919. Chaetochloa sp. (309/05.)

13920. (Native grass.) (310/05.)

13921. Eragrostis major megastachya. (311/05.)

13922. Paniculum sulcatum. (312/05.)

13923. (Native grass.) (313/05.)

13924. (Native grass.) (315/05.)

13925 to 13946. Clematis spp. **Clematis.**

From Philadelphia, Pa. Received thru Henry A. Dreer, Incorporated, May 6, 1905.

13925. Clematis flammula (*Rubra marginata*).

13926. Clematis indivisa.

13927. Clematis coccinea.

13928 to 13945. Clematis spp.

13928. *Anderson Henryi.*

13929. *Boskoop Seedling.*

13930. *Fairy Queen.*

13931. *Duchess of Edinburgh.*

13932. *Gipsy Queen.*

13933. *Jackmani.*

13934. *Jackmani Superba.*

13935. *Lilacina Floribunda.*

13925 to 13946—Continued.

13928 to 13945—Continued.

13936. *M. Koster.*

13937. *Mme. Baron Veillard.*

13938. *Mme. Van Houtte.*

13939. *Miss Bateman.*

13940. *Standishi.*

13941. *The Gem.*

13942. *The President.*

13943. *Countess of Onslow.*

13944. *Duchess of Albany.*

13945. *Duchess of York.*

13946. CLEMATIS INTEGRIFOLIA DURANDII.

13947 to 13949. PHALARIS CANARIENSIS. **Canary grass.**

From Monte, Grand Canary. Presented by Mr. Alaricus Delmard, Hotel Santa Brigada. Received April 24, 1905.

"*Phalaris canariensis*, as a matter of fact, is hardly grown in the islands and mostly comes from the Province of Alicante, in Spain. But one person grows it here, and I will forward you a packet of the seed. Again I regret that I can only discover one variety as grown here. It may have been grown as a crop for the sale of seed in former times in these islands, but certainly is so no longer. The seed I now have comes from Morocco and Buenos Aires, and also from Seville; that from the former two places costs 62 pesetas for 100 kilos, and from Seville 65 pesetas." (*Delmard.*)

13947. Grown in Buenos Aires.

13948. Grown in Morocco.

13949. Grown in Monte.

13950 and 13951. PHALARIS spp.

From San Giovanni a Teduccio, Italy. Received thru Dammann & Co., April 25, 1905.

13950. PHALARIS CANARIENSIS. **Canary grass.**

13951. PHALARIS ARUNDINACEA. **Reed canary grass.**

13952 to 13966. BETA VULGARIS. **Sugar beet.**

Sugar-beet seeds planted at Fairfield, Wash., in the spring of 1905, by Mr. Joseph F. Reed, assistant in sugar-beet experiments, from selected roots.

13952. *Kleinwanzleben;* tested 23 per cent sugar.

Roots selected from Mr. E. H. Morrison's general stock in 1903. Seed raised in 1904.

13953. *Kleinwanzleben;* tested 23 per cent sugar.

Roots selected from No. 12846 (Lehi seed) in 1903. Seed raised in 1904.

13954. *Kleinwanzleben;* tested 22 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13955. *Kleinwanzleben;* tested 21 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13956. *Kleinwanzleben;* tested 20 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13957. *Kleinwanzleben;* tested 19 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13958. *Kleinwanzleben;* tested 19 per cent.

Roots selected from No. 12846 (Lehi seed) in 1903.

13959. *Kleinwanzleben;* tested 18 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13952 to 13966—Continued.

13960. *Kleinwanzleben;* tested 18 per cent.

Roots selected from No. 12849 (Morrison seed), 1903.

13961. *Kleinwanzleben;* tested 18 per cent.

Roots selected from No. 12846 (Lehi seed) in 1903.

13962. *Kleinwanzleben;* tested 17 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13963. *Kleinwanzleben;* tested 16 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13964. *Dippe Elite Kleinwanzleben;* tested 16 per cent.

Roots selected from *Dippe Kleinwanzleben*, 1903.

13965. *Kleinwanzleben;* tested 15 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903.

13966. *Kleinwanzleben;* tested 15 per cent.

Roots selected from Mr. E. H. Morrison's general stock in 1903. The outside seed stalks were cut out, allowing more nourishment to the stalks produced from the inner or sugar rings of the beet.

13967. CARISSA ARDUINA. **Amatungulu.**

From Cape Town, South Africa. Presented by Prof. P. MacOwan, government botanist, Department of Agriculture, Cape of Good Hope. Received April 24, 1905.

"A handsome apocynaceous shrub which may make an ornamental hedge plant in your Southern States. The glittering green of the foliage and the curious rectangular mode of branching catch the eye, but, like some other African Sepiariae, it requires the severest discipline with the shears, and, I must say, submits to it well.

"Even the Apple-of-the-Kei, now spread over the warmer world, is not more destined to the steel than is this Carissa. The flowers are borne in small umbels, brilliantly white, scented, and succeeded by lots of scarlet ovoid fruits, the beloved 'num-nums' of natives and kids generally. I hope you will push it into notice among amateurs. They can make cones or pyramids of it, if they like, in the antique topiary fashion." (*MacOwan.*)

13968 to 13975.

From Pretoria, Transvaal, South Africa. Presented by Prof. J. Burtt Davy, government agrostologist and botanist, Transvaal Department of Agriculture. Received May 15, 1905.

"Small samples of local varieties of wheat, oats, Nepaul barley, and maize. For your guidance in their disposal I may say that this is a region of hot days and cool nights (frosty in winter), with summer rains, and a long, cool, rainless winter. The rainfall runs from 20 to 30 inches, but is discounted by six or seven months of practical drought." (*Davy.*)

13968. AVENA sp. **Oat.**

Boer. (283/05.)

13969. HORDEUM sp. **Barley.**

Tibet. (217/05.)

13970. ZEA MAYS. **Corn.**

Egyptian. (990/04.)

13971. ZEA MAYS. **Corn.**

North American. (992/04.)

13968 to 13975—Continued.

13972. ZEA MAYS. **Corn.**

White Botman Mealie. (694/04.)

13973. TRITICUM VULGARE. **Wheat.**

Klein Koren. (284/05.)

13974. TRITICUM VULGARE. **Wheat.**

Tibet. (216/05.)

13975. TRITICUM VULGARE. **Wheat.**

Wol Koorn. (498/04.)

13976 to 13985. BERBERIS sp. **Barberry.**

From St. Petersburg, Russia. Presented by Messrs. Regel and Kesselring, of the Royal Botanical Gardens. Received May 11, 1905.

13976. BERBERIS SINENSIS.
13977. BERBERIS THUNBERGII MAXIMOWICZI.
13978. BERBERIS THUNBERGII.
13979. BERBERIS VULGARIS.
13980. BERBERIS VULGARIS SULCATA.
13981. BERBERIS VULGARIS AMURENSIS.
13982. BERBERIS VULGARIS EMARGINATA.
13983. BERBERIS VULGARIS MACROCARPA.
13984. BERBERIS VULGARIS PURPUREA.
13985. BERBERIS VULGARIS SPATHULATA.

13986 to 13988.

From Buitenzorg, Java. Received thru Doctor Treub, May 20, 1905.

13986. LANSIUM DOMESTICUM. **Doekoe.**

13987. GARCINIA MANGOSTANA. **Mangosteen.**

13988. NEPHELIUM MUTABILE. **Kapoelasan.**

13989 to 13992.

From New York, N. Y. Received thru J. M. Thorburn & Co., May 12, 1905.

13989. HEDYSARUM CORONARIUM. **Sulla.**

13990. ORNITHOPUS SATIVUS. **Serradella.**

13991. ONOBRYCHIS ONOBRYCHIS. **Sainfoin.**

13992. PISUM ARVENSE. **Canada field pea.**

13993 to 13998.

From Westbury Station, Nassau County, N. Y. Received thru Isaac Hicks & Son, May 25, 1905.

Ornamental plants as follows:

13993. ACER CARPINIFOLIUM.
13994. CORNUS MACROPHYLLA.
13995. CORNUS MACROPHYLLA.
13996. VIBURNUM DILATATUM.
13997. QUERCUS CUSPIDATA.
13998. STUARTIA PSEUDOCAMELLIA.

13999. MEDICAGO SATIVA. **Alfalfa.**

From Ogden, Utah. Received thru Mr. P. A. Nebeker, May 23, 1905.

Turkestan alfalfa, grown on unirrigated land from imported seed (probably S. P. I. No. 991) furnished Mr. Nebeker in 1900.

14000 to 14005. GLADIOLUS spp. **Gladiolus.**

From New York, N. Y. Received from Mr. W. Van Fleet, April 5, 1905.

14000. GLADIOLUS CRUENTUS.

14001. GLADIOLUS PURPUREOAURATUS.

14002. GLADIOLUS DRACOCEPHALUS.

14003. GLADIOLUS PSITTACINUS.

14004. GLADIOLUS SAUNDERSII.

14005. GLADIOLUS LEICHTLINI.

14006 to 14072. GLADIOLUS spp. **Gladiolus.**

From Floral Park, N. Y. Received thru Mr. John Lewis Childs, April 8, 1905.

14006 to 14034. GLADIOLUS CHILDSII.

14035 to 14061. GLADIOLUS GANDAVENSIS.

14062 to 14072. GLADIOLUS LEMOINEI.

14073 to 14087. GLADIOLUS spp. **Gladiolus.**

From Berlin, N. Y. Received thru Mr. Arthur Cowee, April 12, 1905.

14088 to 14155. GLADIOLUS spp. **Gladiolus.**

From Nancy, France. Received thru V. Lemoine & Son, May 4, 1905.

14156 to 14259. GLADIOLUS spp. **Gladiolus.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., May 10, 1905.

14260 to 14267. GLADIOLUS spp. **Gladiolus.**

From Erfurt, Germany. Received thru Haage & Schmidt, May 10, 1905.

14268 to 14412. GLADIOLUS spp. **Gladiolus.**

From Somerset, England. Received thru Kelway & Sons, Langport, May 12, 1905.

(See the circular of the Bureau of Plant Industry entitled "A Variety Collection of Gladiolus," 1905.)

14413 to 14418.

From Sultepec, Mexico. Presented by Mr. Federico Chisolm. Received May 12, 1905.

A small collection of unidentified plants.

14419. TULIPA sp. **Tulip.**

From Dedham, Mass. Received thru Mr. A. W. Cheever, August 25, 1905.

14420 and 14421. NICOTIANA TABACUM. **Tobacco.**

From Sao Paulo, Brazil. Presented by Dr. H. M. Lane, Mackenzie College. Received May 25, 1905.

14420. *Fumo Creolo.* Seed from near Cotia, State of Sao Paulo, Brazil.

14421. Seed from Pirassununga, State of Sao Paulo, Brazil.

14422 to 14431.

From Honolulu, Hawaii. Presented by Mr. Ralph S. Hosmer, superintendent of forestry, Hawaiian Bureau of Agriculture and Forestry. Received May 31, 1905.

14422. RAUWOLFIA SANDWINCENSIS.

Native name *Hao.* A small, milky tree.

14422 to 14431—Continued.

14423. Cheirodendron gaudichaudii.

Native name *Olapa.* A tree 30 to 50 feet high. The natives prepare a blue dye from the bark and leaves.

14424. Maba sandwicensis.

Native name *Lama.* Grows to a height of from 20 to 40 feet.

14425. Caesalpinia kauaiensis.

Native name *Uhiuhi.* A low shrub 3 to 4 fee

14426. Erythrina monosperma.

Native name *Wiliwili.* An ornamental tree 20 to 25 feet high, with short, thick trunk and spreading crown. The tree loses its leaves in late summer, and in the spring before the new leaves are out scarlet flowers appear. The wood is soft and corklike.

14427. Dracaena aurea.

Native name *Halapepe.* A glabrous tree 20 to 25 feet high, from the wood of which the natives used to carve their idols.

14428. Myrsine lassertiana.

Native name *Kolea.* A tree 20 to 50 feet high. The natives used to extract a red dye from the bark.

14429. Alphitonia ponderosa.

Native name *Kauwila.* A tall tree, often attaining 50 to 83 feet. The wood is remarkable for close grain, hardness, and heavy weight, on which account the natives preferred it for making spears, mallets for beating kapa, and other tools; turns black with age.

14430. Dodonaea viscosa.

Native name *Aalii.*

14431. Myoporum sandwicensis.

"Native name *Naeo.* English name 'bastard sandalwood.' Tree 20 to 30 feet high. The wood of this tree, most so the roots, becomes fragrant on drying, with an odor resembling that of sandalwood, whence its English name. After the exhaustion of the true sandalwood it was exported for some time to China as a substitute." (*Hillebrand.*)

14432. Gerbera jamesoni. **Barberton daisy.**

From Lourenço Marquez, East Africa. Presented by Mr. A. E. Graham-Lawrence, thru Hon. W. Stanley Hollis, United States consul. Received July 14, 1905.

14433. (Undetermined.) **"Lemoncito."**

From Manila, P. I. Received thru Capt. George P. Ahern, chief of the Bureau of Forestry, Manila Bureau of Agriculture, July 17, 1905.

"This is a small plant, the height of which does not exceed one and one-half of that of a man, and is known only by the name of 'lemoncito.' It usually has about five very leafy branches. Its trunk is nearly 20 centimeters in diameter, of a light-yellow color, with blackish spots hardly perceptible, and of a fine fibrous texture. It is not very well known by the common people. Its branches are slender and produce leaves in groups of three, the middle one being the largest; in the growth of the leaves are found thorns somewhat pronounced; the groups of leaves are arranged in alternating order on either side of the branch up to the end. Its trunk has no odor, but its fruit has an agreeable odor somewhat like maraschino. They appear between the groups of leaves at the time of opening of the calyx of a flower from which they come, and are sometimes found in clusters and sometimes single. In the month of May this plant produces fruit in abundance and they ripen in a few days.

They have an oval form with a pronounced fiery color, are aromatic and edible with a somewhat acrid yet sweet taste.

"Commonly people who have lemoncito trees make sirup from the ripened fruit and also preserve them." (*Ahern.*)

14434 to 14463.

From Mexico. Secured by Prof. P. H. Rolfs, in charge of the Subtropical Laboratory, Miami, Fla., while traveling in Mexico as agricultural explorer of the Office of Seed and Plant Introduction in April, May, and June, 1905.

14434. PRUNUS sp. **"Ceruella."**

"A form of native Prunus, resembling the peach in color, about the size of a damson plum. Secured at Jalapa, Mexico. This plum grows in that neighborhood; consequently it is possible that seedlings from it will be able to maintain themselves in extreme southern Florida and Porto Rico. (Lab. No. 289.)" (*Rolfs.*)

14435. PERSEA GRATISSIMA. **Avocado.**

"A small quantity of bud wood secured from a tree that blooms in January and ripens fruit in May. The special value of this particular tree lies in the fact that it ripens in so short a time after blooming. The fruit, altho delicious and otherwise good, is too small to prove of value on the market. Its special value, however, lies in the fact that when it comes into bearing it can be used for hybridizing with the early forms that do have marketable fruit, and consequently the introduction is very desirable. (Lab. No. 295.)" (*Rolfs.*)

14436. CUCURBITA sp. **Squash.**

"This is a peculiar native (?) squash that is grown to some extent for the market, and it is possible that it would be of use in the Southern States for a summer vegetable on account of its extremely hard outer skin. (Lab. No. 296.)" (*Rolfs.*)

14437. CAESALPINIA sp.

"This is a flowering shrub found at Papantla, State of Vera Cruz. It resembles to some extent a plant already grown in Florida and known as the *dwarf Poinciana* (*Caesalpina pulcherrima*). It differs from this, however, in producing a much greater abundance of flowers and growing about twice the height. It is a distinct species from that mentioned. (Lab. No. 297.)" (*Rolfs.*)

14438. FICUS sp.

"A number of ripe fruits of this tree were secured from the public garden at Papantla. The fruits are about the size of black walnuts, and are inedible, tho not of unpleasant flavor; but the tree is very decorative. In general character of the tree and look of the leaves, this species would classify near *Ficus carica.* (Lab. No. 298.)" (*Rolfs.*)

14439. HIBISCUS sp.

"An Hibiscus that appears to be a native, bearing a very dark maroon-colored bloom. Quite showy and striking. (Lab. No. 299.)" (*Rolfs.*)

14440. VANILLA sp. **"Pompon."**

"This species is a very strong-growing vanilla. Produces the largest pods and in considerable quantity. Secured near Papantla, Vera Cruz. (Lab. No. 308.)" (*Rolfs.*)

14441. VANILLA PLANIFOLIA (?). **Vanilla.**

"This number appears to be the true *V. planifolia*, but could not be identified. It, however, is one of the vanilla-producing species. (Lab. No. 309.)" (*Rolfs.*)

14442. VANILLA PLANIFOLIA. **Vanilla.**

"This was secured from a vaniliary some 10 or 12 miles from Papantla. It is probably the true *V. planifolia.* It is from this species that most of the commercial material is produced in this section. (Lab. No. 310.)" (*Rolfs.*)

14434 to 14463—Continued.

14443. VANILLA sp. **Vanilla.**

"The exact status of this number can not be learned until the flowers and fruit shall have been studied. It is, however, not *V. planifolia.* (Lab. No. 311.)" (*Rolfs.*)

14444. VANILLA sp. **Vanilla.**

"This is rather a weak-growing species of the vanilla genus, but I have been told that it produces beans of unusual strength. Secured on the Isthmus of Tehuantepec. (Lab. No. 312.)" (*Rolfs.*)

14445. VANILLA sp. **Vanilla.**

"This is a very narrow-leaved species. It is not a vigorous grower, but is said to be of considerable value. Secured on the Isthmus of Tehuantepec. (Lab. No. 313.)" (*Rolfs.*)

14446. VANILLA sp. **Vanilla.**

"Quite similar to 313 and may prove to be the same species, but in the field it showed considerable difference, due to the place where it was growing. Secured on the Isthmus of Tehuantepec. (Lab. No. 314.)" (*Rolfs.*)

14447. BAMBUSA VULGARIS (?). **Bamboo.**

"This gigantic-growing bamboo was seen all along the way from a few miles below Teziutlan to Papantla. It has become rather thoroly established, and would appear to be a native of this region. A small quantity of good seed was obtained from fruiting specimens. (Lab. No. 316.)" (*Rolfs.*)

14448. MANGIFERA INDICA. **Mango.**

"Seed of what is commonly called *Manila* mango. This is probably the same mango that is called the *Philippine* mango in Cuba. Very little fiber. Fruit very long, about 5 inches, sometimes longer than this, about 3 inches broad at its broadest, about 1½ to 2 inches thick. Delicious flavor, free from turpentine, and the best varieties can be eaten with a spoon, it being possible to cut the fiber with an ordinary teaspoon. (Lab. No. 317.)" (*Rolfs.*)

14449. CARICA PAPAYA. **Papaw.**

"A very handsome specimen of this fruit was purchased for the seed. (Lab. No. 318.)" (*Rolfs.*)

14450. CASTILLA ELASTICA. **Rubber.**

(Lab. No. 319.)

14451. LYCOPERSICUM ESCULENTUM. **Tomato.**

"A small tomato, which is said to be a native of Mexico and one that occurs very commonly, especially on the Isthmus of Tehuantepec. (Lab. No. 320.)" (*Rolfs.*)

14452. ANANAS SATIVUS. **Pineapple.**

"Known as the *Guatemala Spineless White.* This variety has a number of points that would commend it for our use—spineless, ripens early, is delicious, and apparently a good shipper. (Lab. No. 323.)" (*Rolfs.*)

14453. CICER ARIETINUM. **Chick-pea.**

"This is a legume which in some respects resembles the English pea, and is used very largely in preparing soups and dishes of that kind. It is not generally used in this country, but if it should prove to do well the Spanish market would use all that could be furnished for some time. (Lab. No. 327.)" (*Rolfs.*)

14454. CASIMIROA EDULIS. **White sapota.**

(Lab. No. 328.)

14455. **"Haba."**

"A legume to be found on most of the markets. (Lab. No. 329.)" (*Rolfs.*)

14434 to 14463—Continued.

14456. PRUNUS sp. **"Ceruella."**

"This species is said to be a native of Mexico and to grow very luxuriantly in the regions where oranges are produced. If this could be grown in Florida and Porto Rico it would be a very desirable acquisition. (Lab. No. 331.)" (*Rolfs.*)

14457. MUSA ENSETE.

"Seed secured in Mexico City. (Lab. No. 332.)" (*Rolfs.*)

14458. BACTRIS MAJOR. **Palm.**

"Very ornamental palm from the Isthmus of Tehuantepec. (Lab. No. 333.)" (*Rolfs.*)

14459. ZEA MAYS. **Corn.**

"Corn that grows along the Isthmus of Tehuantepec. It has some qualities that may adapt it for growth in the extreme southern part of the United States. (Lab. No. 334.)" (*Rolfs.*)

14460. **"Haba."**

"Seed of another species of legume, which occurs commonly on the various markets in Cuba. (Lab. No. 335.)" (*Rolfs.*)

14461. **"Bayo."**

"Seed of another legume. Secured in the Vera Cruz market. (Lab. No. 337.)" (*Rolfs.*)

14462. ERVUM LENS. **Lentil.**

"Appears to be a lentil, as grown in Europe. Secured in the Vera Cruz market. (Lab. No. 338.)" (*Rolfs.*)

14463.

"Seed of the tree referred to under 'No. 295.' (Lab. No. 339.)" (*Rolfs.*)

14464. CINNAMOMUM CAMPHORA. **Camphor.**

This number (14464) was assigned to camphor plants distributed by Mr. E. M. Byrnes, superintendent of gardens and grounds, in order to keep a record of the distribution.

The seeds from which the plants were grown came from various sources.

14465. ZEA MAYS. **Corn.**

From Houston, Tex. Received thru Dr. S. A. Knapp, July 14, 1905.

Laguna. Secured by Doctor Knapp from Mexico. "This is a new variety. Was grown in Texas. In the latitude of north Texas this could be planted as late as the first of August." (*Knapp.*)

14466. TRIFOLIUM INCARNATUM. **Crimson clover.**

From Richmond, Va. Received thru T. W. Wood & Son, July 20, 1905.

Late.

14467. VICIA VILLOSA. **Hairy vetch.**

From Richmond, Va. Received thru T. W. Wood & Son, July 20, 1905.

14468. VICIA FABA. **Horse bean.**

From Montreal, Canada. Received thru William Ewing & Co., July 20, 1905.

14469. GOSSYPIUM sp. **Cotton.**

From Chicago, Ill. Received thru Mr. I. L. Hauser (?), 225 Dearborn street, July 17, 1905.

14470. ERAGROSTIS ABYSSINICA. **Teff.**

From San Giovanni a Teduccio, near Naples, Italy. Received thru Dammann & Co., July 21, 1905.

14471. XANTHOSOMA SAGITTIFOLIUM. **Yautia.**

From Mayaguez, P. R. Received from the Agricultural Experiment Station, July 24, 1905.

"This variety is in many respects the best of all the yautias cultivated in tropical America. It yields 3 to 5 pounds to the hill, and can be grown on a great variety of soils. It requires about ten months to mature.

"This variety is known as '*Rolliza*' in Porto Rico. It is also grown in Trinidad, Venezuela, and Balize, British Honduras. The fresh roots contain 20 per cent to 28 per cent of starch, with very little fiber. 'No. 1,' of P. R. Exp. Station." (*Barrett.*)

14472 and 14473.

From Manila, P. I. Received thru Capt. George P. Ahern, chief of the Bureau of Forestry, July 24, 1905.

14472. ORANIA PHILIPPINENSIS. **Palm.**

"A palm indigenous to the Philippine Islands." (*Ahern*)

14473. PANDANUS LUZONENSIS.

"A plant indigenous to the Philippine Islands, found at elevations up to 600 meters above sea level. Apparently closely related to *Pandanus sylvestris* Bory, from the island of Reunion, differing in its larger size, longer leaves, etc. Described in Bulletin No. 17, Bureau of Government Laboratories, Manila, P. I., 'New or Noteworthy Philippine Plants, II,' by Botanist Elmer D. Merrill." (*Ahern.*)

14474. VIGNA SINENSIS. **Cowpea.**

From Grovetown, Ga. Received thru Mr. W. W. Hamilton, July 26, 1905.

14475. SOLANUM COMMERSONI. **Aquatic potato.**

From Montevideo, Uruguay. Received thru Dr. J. Clyde Macartney, July 25, 1905.

14476. OPUNTIA sp. **Prickly pear.**

This number (14476) was assigned to about 500 seedling cacti sent by Mr. Luther Burbank, Santa Rosa, Cal., to Dr. S. A. Knapp, San Antonio, Tex., for planting on the Government demonstration farm.

14477 to 14479.

From City of Mexico, Mexico. Received thru Dr. J. N. Rose, of the United States National Museum, July 28, 1905.

A collection of unidentified plants.

14480. IPOMOEA BATATAS (?). **Dahomey sweet potato.**

From Bordeaux, France. Received thru Hon. Albion W. Tourgee, United States consul, July 31, 1905.

This plant "is a native of Dahomey and very prolific. The leaves of the plant can be used as a substitute for spinach, and the tubers, containing a higher percentage of sugar than beets, are fine flavored and make exceptionally good food for live stock." (*Tourgee.*)

14481. LILIUM LONGIFLORUM EXIMEUM. **Easter lily.**

From Washington, D C. Received July 31, 1905. Selected bulbs grown in the Department greenhouses.

14482. JUNCUS EFFUSUS. **Matting rush.**

From California. Collected under the direction of Prof. A. V. Stubenrauch. Roots secured from California marshes for work on the matting-rush industry.

14483. CYPERUS sp.

From Kobe, Japan. Received thru Mr. A. G. Boyer, at North Galveston, Tex., April, 1904.

14484 and 14485. CAPSICUM ANNUUM. **Pepper.**

From Malaga, Spain. Received thru Hon. D. R. Birch, United States consul, July 31, 1905.

14484. *Chile.* **14485.** *Large red sweet coin.*

"This pepper is the most common variety on sale here, and the fruits are usually about 8 inches in length." (*Birch.*)

14486. SCHOENOCAULON OFFICINALE (?). **"Cebadilla."**

From San Luis Potosi, Mexico. Received thru Dr. Edward Palmer from Dr. Gregorio Borroeta, July 31, 1905.

An insecticide wash for cattle infected with ticks is said to be prepared from these plants. Related to the fly-killer (*Amiranthium muscaetoxicum*) and to the green hellebore (*Veratrum*). Imported for experiments in Cuba.

14487. PRUNUS SIBIRICA. **Siberian apricot.**

From Jamaica Plain, Mass. Received thru the Arnold Arboretum, July 28, 1905.

This variety is said to be perfectly hardy in Massachusetts.

14488. BIDENS HETEROPHYLLA. **"Malpe" tea.**

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, August 1, 1905.

"A great part of the stuff sold as 'tea' in Mexico is the rolled leaves of this plant." (*Chisolm.*)

14489. (Undetermined.)

From Tacoma, Wash. Presented by Gen. William G. Le Duc. Received July 27, 1905.

"Plant said to be used by the Indians as a cure for 'mountain fever;' fruits are edible." (*Le Duc.*)

14490. SOLANUM TUBEROSUM. **Potato.**

From Edinburgh, Scotland. Secured by Prof. L. R. Jones, of the Vermont Experiment Station, from T. A. Scarlett, and sent direct to Burlington, Vt.

El Dorado. "A potato that is of peculiar prominence for disease resistance. In 1904 speculation forced the price as high as $16 a pound." (*Jones.*) (See No. 13034.)

14491. NARCISSUS POETICUS ALBA fl. pl.

From Edinburgh, Scotland. Received thru the Royal Botanical Gardens, August 7, 1905.

14492. PANICUM MAXIMUM. **Guinea grass.**

From Australia. Received thru J. M. Thorburn & Co., New York, N. Y., May 25, 1905.

14493 to 14497.

From Paris, France. Received thru Vilmorin-Andrieux & Co., May 26, 1905.

Clover and alfalfa seeds:

14493. TRIFOLIUM PRATENSE. **Red clover.**

Trefle, violet de Russie.

14494. TRIFOLIUM INCARNATUM. **Crimson clover.**

Trefle, incarnat de Russie.

14495. TRIFOLIUM REPENS. **White clover.**

Trefle, blanc de Russie.

14496. MEDICAGO SATIVA. **Alfalfa.**

Luzerne de Pensa (Simbirsk).

14497. MEDICAGO SATIVA. **Alfalfa.**

Luzerne de Charkow.

14498. PERSEA INDICA.

From Monte, Grand Canary. Presented by Mr. Alaricus Delmard. Received June 1, 1905.

Seeds from Teneriffe. "Procured for the purpose of growing stocks upon which to graft seedling avocado (*Persea gratissima*) for planting in localities which require a more hardy stock than the latter." (*Fairchild.*)

14499. VIGNA SINENSIS. **Cowpea.**

From Richmond, Va. Received thru T. W. Wood & Sons, June 1, 1905.

Wonderful.

14500 to 14775. ANDROPOGON SORGHUM. **Sorghum.**

From Bombay Presidency, India. Received by the Office of Grass and Forage Plant Investigations, April 27, 1903, from Hon. J. W. Mollison, Inspector-General of Agriculture in India. Turned over to the Office of Seed and Plant Introduction and numbered in the spring of 1905.

A collection of sorghums obtained from Surat Farm, Bombay Presidency.

14500. *Dhavla* (A).
14501. *Kar Juar.*
14502. *Garia Yellow.*
14503. *Ellichpuri.*
14504. *Gare.*
14505. *Akada.*
14506. *Garia Yellow* (A).
14507. *Yellaspuri.*
14508. *Kalbondi.*
14509. *Dhavla.*
14510. (Variety from Sampgaon.)
14511. *Akada* (A).
14512. *Sadagar.*
14513. *Kar Juar* (A).
14514. *Patasi.*
14515. *Nirmali.*
14516. *Gare Nasik.*
14517. *Akada* (B).
14518. *Akada* (C).
14519. *Gangad.*
14520. *Garia Dhavla.*
14521. *Akada* (D).
14522. *Gavathi.*
14523. *Nilwa Khandesh.*
14524. *Bile Juar.*
14525. *Kondal.*
14526. *Gari.*
14527. *Gudhagi.*
14528. *Dukri.*
14529. *Juari.*
14530. *Dakshni.*
14531. *Mergar* (B).
14532. *Kar Juar* (B).

14500 to 14775—Continued.

14533. *Akada.*
14534. *Mergari.*
14535. *Meldani.*
14536. *Fulgar* (A).
14537. *Nadial.*
14538. *Jowala.*
14539. *Akada* (E).
14540. *Adola.*
14541. *Bile Juar* (A).
14542. *Akada Khandesh.*
14543. *Garia* or *Dhavla.*
14544. *Kondi.*
14545. *Rati.*
14546. *Gid-Gidgempu.*
14547. *Fulgar Karajgi.*
14548. *Mumtnigal.*
14549. (Sampgaon variety No. 2)
14550. *Pandharpuri Ramker.*
14551. *Deola.*
14552. *Saphet.*
14553. *Lawhi.*
14554. *Haldi.*
14555. *Pivali Wani.*
14556. *Narli Wani.*
14557. *Ushira.*
14558. *Kalbondi.*
14559. *Edna.*
14560. *Dudhawani.*
14561. *Charoli Wani.*
14562. *Dukri* or *Talap.*
14563. *Daner.*
14564. *Bansmati.*
14565. *Lokhamdi.*
14566. *Deolari.*
14567. *Argar.*
14568. *Bagle* or *Supte.*
14569. *Ringna.*
14570. *Motichur.*
14571. *Badgonda.*
14572. *Baidria.*
14573. *Deola* (A).
14574. *Ganer.*
14575. *Mohwani.*
14576. *Bani.*
14577. *Pawana Nadi.*
14578. *Baidra* (A).
14579. *Lal Gunja.*
14580. *Patasi Juar.*
14581. *Motichur.*
14582. *Sholapuri.*
14583. *Nadyal.*
14584. *Juari.*
14585. *White Dumraon.*
14586. *Gumeri.*
14587. *Dukri.*
14588. *Durga.*
14589. *Bana of Jalaon.*
14590. *Bhanna of Jhansi.*
14591. *Lal.*
14592. *Jharloo.*
14593. *Doliya.*
14594. *Bania.*
14595. *Laliya.*
14596. *Supeta.*
14597. *Kombrai.*
14598. *Pyaria Iksari Banda.*
14599. *Iksari Banda.*
14600. *Pyaria.*
14601. *Safed Dupta Banda.*
14602. *Alapuri.*
14603. *Dulari.*
14604. *Dugadia Zard.*
14605. *Ikdani.*
14606. *Purbi Magha.*
14607. *Country White.*
14608. *Gugadia Safed.*
14609. *Jogia.*
14610. *Domni.*
14611. *Chatka.*
14612. *Bangra.*
14613. *Lallu.*
14614. *Bedaer.*
14615. *Gugadia.*
14616. *Gogla.*
14617. *Purbi Murabad.*
14618. *Deshi.*
14619. *Ganga Jamni.*

14500 to 14775—Continued.

14620. *Jamnapuri.*
14621. *Juar of Bijnore.*
14622. *Bannia Dadri.*
14623. *Pirbahi Lucknow.*
14624. *Pirbahi Unao.*
14625. *Dadri of Unao.*
14626. *Red of Ajangarh.*
14627. *Bannia.*
14628. *Jhalaria.*
14629. *Paundia.*
14630. *Dudhia.*
14631. *Jhangaria.*
14632. *Jhalria.*
14633. *Bannia of Sitapur.*
14634. *Palarhia.*
14635. *White of Ray Barelly.*
14636. *Natwa.*
14637. *Lagwa.*
14638. *Red.*
14639. *White.*
14640. *Mailki.*
14641. *Ganga Jali.*
14642. *Dudghiya.*
14643. *Nerio Perio.*
14644. *Bannia of Cawnpur.*
14645. *Nandiyal.*
14646. *Kabgar.*
14647. *Lohor.*
14648. *Yennigar.*
14649. *Mamadpuri Gidd.*
14650. *Vilayati* or *Kempugidd.*
14651. *Kalia Gondicha Vilayati.*
14652. *Mud Shedgar.*
14653. *Khabba Shedgar.*
14654. *Vibhuti Gund.*
14655. *Kala Gund.*
14656. *Moti Jondhala.*
14657. *Paramsali.*
14658. *Udda Maldani.*
14659. *Gidd Maldani.*
14660. *Bilegar.*
14661. *Gund.*
14662. *Bile Nandiyal.*
14663. *Amaldani.*
14664. *Baswanpad.*
14665. *Shedgar.*
14666. *Shalu.*
14667. *Makchandri.*
14668. *Holgi.*
14669. *Hundi.*
14670. *Zamli.*
14671. *Kagi Moti.*
14672. *Mangar.*
14673. *Kalbondi.*
14674. *Duhar Maski.*
14675. *Bendri.*
14676. *Guldhavi.*
14677. *Lakdi.*
14678. *Shalu.*
14679. *Nilwa.*
14680. *Gola.*
14681. *Nirwati.*
14682. *Gari.*
14683. *Ellichpuri.*
14684. *Khondi Chandor.*
14685. *Lakadia Juar.*
14686. *Dukri.*
14687. *Dadar.*
14688. *Khonde Malegaon.*
14689. *Shalu.*
14690. *Lagwa* (A).
14691. *Dagdi.*
14692. *Red* (erect-headed of No. 14638).
14693. *Juar Nandgaon.*
14694. *Shalu.*
14695. *Argad.*
14696. *Dukri.*
14697. *Hundi.*
14698. *Gidd-Gapp.*
14699. *Waradi Juar.*
14700. *Hundi.*
14701. *Jondhala.*
14702. *Maldani.*
14703. *Tambdi.*
14704. *Gudadi.*
14705. *Jagadi.*
14706. *Dadia.*

14500 to 14775—Continued.

14707. *Farfaria.*
14708. *Deshi Perio.*
14709. *Sholapuri.*
14710. *Chapti.*
14711. *Perio Halko.*
14712. *Nialo.*
14713. *Ratadia.*
14714. *Juar.*
14715. *Sundhia.*
14716. *Komasu Juar.*
14717. *Shalu Juar.*
14718. *Malvan.*
14719. *Utavli.*
14720. *Sakar Makar.*
14721. *Sundhia* (B).
14722. *Sorghum Amber.*
14723. *Sorghum Collier.*
14724. *Raj. Hansa.*
14725. *Imphee.*
14726. *Sakar Makar* (A).
14727. *Kend.*
14728. *Motichur.*
14729. *Perio.*
14730. *Sholapuri.*
14731. *Chapti.*
14732. *Nialo.*
14733. *Rati* (A).
14734. *Jogadi.*
14735. *Ellichpuri* (A).
14736. *Ellichpuri* (B).
14737. *Nilwa Poona* (not ordinary).
14738. *Kempu* (C).
14739. *Mevgar* (A).
14740. *Gidd Juari.*
14741. *Wani Perio.*
14742. *Kempu Poona.*
14743. *Kempu.*
14744. *Kempu* (A).
14745. *Kempu* (B).
14746. *Kachakachi.*
14747. *Gundi Teni.*
14748. *Kempu Malkin.*
14749. *Holgi Gola.*
14750. *Dudha Mogra.*
14751. *Tambdi Sholapuri.*
14752. *Dukri* (A).
14753. *Dukri* (B).
14754. *Sargad.*
14755. *Gund Chikodi.*
14756. *Gund Chikodi* (A).
14757. *Gund* (A).
14758. *Paramsali.*
14759. *Hassar Juar* (Sampgaon).
14760. *Hassar.*
14761. *Holgi Jola.*
14762. *Chikna.*
14763. *Maldani* (A) (Poona).
14764. *Kempu* (D).
14765. *Vairagad Belsi.*
14766. *Kagi.*
14767. *Darker.*
14768. *Darker* (A).
14769. *Sundhia Juwar* (Poona Farm).
14770. *Nilwa* (Bombay Presidency).
14771. *Utavli.*
14772. *Kavli.*
14773. *Charodi* (Surat Farm).
14774. *Ameria Sundhia* (Nadiad Farm).
14775. *Farfaria.*

14776. PANICUM MAXIMUM. **Guinea grass.**

From Sydney, New South Wales. Presented by Anderson & Co., George street. Received June 3, 1905.

14777. OPUNTIA FICUS-INDICA. **Prickly pear.**

From Honolulu, Hawaii. Presented by Mr. C. C. Conradt. Received June 3, 1905.

14778. Juncus effusus conglomeratus. **Matting rush.**

From Cat Island, S. C. Collected by Mr. J. H. Tull, June 1, 1905.

14779 to 14785. Oryza sativa. **Rice.**

From Nagpur, India. Presented by Hon. J. W. Mollison, Inspector-General of Agriculture. Received June 5, 1905.

14779. *Badshah Bhog.*

"A fine-scented variety grown in Bengal Presidency. Grows best on clay or sandy loam, and requires ample water till the variety comes into ear." (*Mollison.*)

14780. *Welchi.*

"A coarse variety grown in Bombay Presidency. Requires black soil and ample water till ripening." (*Mollison.*)

14781. *Kamod.*

"A fine-scented variety grown in Bombay Presidency. Grows on black or light soil, and requires ample water till ripening." (*Mollison.*)

14782. *Basmati.*

(See remarks on No. 14779.)

14783. *Dad Khani.*

(See No. 14779, with the exception that this is not a scented variety.)

14784. *Ambe Mohr.*

"A fine-scented variety grown in Bombay Presidency. Requires black soil and ample water till ripening." (*Mollison.*)

14785. *Katri Bhog.*

(See remarks on No. 14783.)

14786. Medicago sativa. **Alfalfa.**

From Tashkend, Turkestan. Received thru Mr. H. W. Dürrschmidt, June 3, 1905.

14787. Opuntia sp. **Prickly pear.**

From San Luis Potosi, Mexico. Received from Dr. Edward Palmer, thru Dr. J. N. Rose, of the United States National Museum, June 9, 1905.

Tuna Tapona de Castilla.

14788. Freesia sp.

From Burnett, Cal. Received thru Rees & Compere, June 12, 1905.

14789. Nerine sp.

From Raleigh, N. C. Received thru Prof. W. F. Massey, Agricultural Experiment Station, June 12, 1905.

14790. Hyacinthus orientalis. **Roman hyacinth.**

From Burnett, Cal. Received thru Rees & Compere, June 13, 1905.

Albulus. From S. P. I. No. 12233. Received from J. M. Thorburn & Co. in the autumn of 1904.

14791 to 14798. Zea mays. **Corn.**

From Richmond, Va. Received thru T. W. Wood & Sons, June 13, 1905.

Recommended to be the best varieties of corn for feeding green to stock; to be tested on sandy land near Washington, D. C.

14791. *Cocke's Prolific.*
14792. *White Columbia.*
14793. *Hickory King.*
14794. *Mammoth Shoe Peg.*
14795. *Holt's Strawberry.*
14796. *Eureka.*
14797. *Virginia Ensilage.*
14798. *Blount's Prolific.*

14799. FREESIA sp.

From Great Neck, Long Island, N. Y. Received thru Mr. Rudolph Fischer, June 13, 1905.

Purity.

14800. SOLANUM TUBEROSUM. **Potato.**

From Elmira, N. Y. Received thru Prof. L. R. Jones from Mr. C. F. Vanderhoff, Oak Grove fruit farm, May 18, 1905.

Blightproof. "Recommended as remarkably resistant to disease (blight) and also excelling in yield, size, uniformity, and compactness of tuber development in the hills." (*Jones.*) (L. R. Jones's No. 64.)

14801. GOSSYPIUM sp. **Cotton.**

From Lima, Peru. Received thru W. R. Grace & Co., New York, N. Y., June 7, 1905.

Seed of Peruvian cotton grown at Ica, in the southern part of Peru.

14802 to 14805.

From Pfiffelbach, near Apolda, Germany. Received thru Mr. A. Kirsche, June 8, 1905.

14802. AVENA SATIVA. **Oat.**

14803. TRITICUM VULGARE. **Wheat.**

Spring.

14804. BETA VULGARIS. **Beet.**

Ideal.

14805. DAUCUS CAROTA. **Carrot.**

14806 to 14810. OPUNTIA FICUS INDICA. **Prickly pear.**

From Malta. Received thru Dr. G. Borg, of San Giovanni, June 12, 1905.

14806. Small, yellow-fruited, seedless.

14807. White-fruited.

14808. Red-fruited.

14809. Reddish yellow fruited, seedless.

14810. Yellow-fruited.

14811. POLIANTHES TUBEROSA. **Tuberose.**

From Austin, Tex. Presented by Mr. F. T. Ramsey. Received June 16, 1905.

14812. LILIUM PHILIPPINENSE. **Benguet lily.**

From Boston, Mass. Received thru R. & J. Farquhar & Co., June 16, 1905.

14813 and 14814.

From Manila, P. I. Received thru Prof. William S. Lyon, horticulturist in charge of seed and plant introduction, Bureau of Agriculture, Manila, P. I., June 6, 1905.

14813. ERIODENDRON ANFRACTUOSUM.

"The lint with us is a better color than some of the kapok that comes from Java, and commands a better price in this market. It is, I think, perhaps due more to climatic or soil influences than to any varietal difference." (*Lyon.*)

14814. ORANIA PHILIPPINENSIS.

"Pericarp rich in starch—24 per cent. Very ornamental." (*Lyon.*)

14815. NEPHELIUM MUTABILE. **Kapoelasan.**

From Buitenzorg, Java. Presented by Doctor Treub, director of the Department of Agriculture. Received June 19, 1905.

14816 to 14821. OPUNTIA FICUS INDICA. **Prickly pear.**

From Palermo, Sicily. Received thru Dr. A. Borzi, director of the Botanic Gardens, June 10, 1905.

14816. *Zuccarina.*
14817. *Frutti Sanguinei.*
14818. *Senza Chiupi.*
14819. *Rossi.*
14820. *Bianchi.*
14821. (Miscellaneous; unlabeled.)

14822 to 14839. OPUNTIA spp. **Tuna.**

From San Luis Potosi, Mexico. Received from Dr. Edward Palmer, thru Doctor Rose, of the National Museum, June 19, 1905.

14822. *Blanca Crystalina.* (Doctor Rose's No. 580/05.)
14823. *Redonda Colorado.* (581/05.)
14824. *Pachona.* (582/05.)
14825. *Cueja.* (583/05.)
14826. *Joconostle.* (595/05.)
14827. *Durasnillo Blanco.* (597/05.)
14828. *Narancada.*
14829. *Cueja Arantidea.* (600/05.)
14830. *Mansa Colorado.* (600/05.)
14831. *Cacalota Blanca.* (604/05.)
14832. *Camuesa* or *Camessa.* (606/05.)
14833. *Tuna Blanca.* (607/05.)
14834. *Xoconochtli Agre.* (608/05.)
14835. *Joconostle Cambria.* (609/05.)
14836. *Cameosa Color de Rose.* (610/05.)
14837. *Amerea Mansa.* (612/05.)
14838. *San Miguel Lania.* (617/05.)
14839. *Nopalea.* (661/05.)

"An opuntia found in the dense wood to the height of 20 or more feet. Where found alone exposed it has a neat, rather compact top, with a naked stem of 7 to 9 feet and from 6 to 8 inches in diameter, with bunches of thorns up the stem. The fruits are small." (*Palmer.*)

14840 to 14869.

From Frescati, near Stockholm, Sweden. Presented by Prof. Veit Wittrock, June 21, 1905.

A collection of grass and forage crop seeds:

14840. AGROSTIS ASPERULA.
14841. AVENA PLANICULMIS.
14842. BROMUS ANDINUS.
14843. DACTYLIS ASCHERSONIANA.
14844. ELYMUS CHUBUTENSIS.
14845. ELYMUS SABULOSUS.
14846. PHLEUM MICHELII.
14847. POA ATTICA.
14848. TRITICUM CRISTATUM.
14849. TRITICUM DASYANTHUM.
14850. TRITICUM DESERTORUM.
14851. TRITICUM INTERMEDIUM.
14852. TRITICUM VIOLACEUM.
14853. MEDICAGO CARSTIENSIS.
14854. MELILOTUS ELEGANS.
14855. MELILOTUS SULCATA.
14856. MELILOTUS TOMMASINI.
14857. TRIFOLIUM ALPESTRE.
14858. TRIFOLIUM BADIUM.
14859. TRIFOLIUM MONTANUM.

14840 to 14869—Continued.

14860. TRIFOLIUM OCHROLEUCUM.

14861. TRIFOLIUM RUBENS.

14862. VICIA ALTISSIMA.

14863. VICIA CALCARATA.

14864. VICIA DASYCARPA.

14865. VICIA DISPERMA.

14866. VICIA DUMETORUM.

14867. VICIA GRANDIFLORA KITAIBELIANA.

14868. VICIA PISIFORMIS.

14869. VICIA SEPIUM.

14870. GOSSYPIUM sp. **Cotton.**

From Cartavio, Peru. Presented by Mr. T. F. Sedgwick, of the Cartavio Sugar Company. Received June 14, 1905.

14871 to 14878. NICOTIANA TABACUM. **Tobacco.**

From Sao Paulo, Brazil. Presented by Dr. H. M. Lane, Mackenzie College. Received June 20, 1905.

Brazilian tobacco seed:

14871. *Georgiana.* From Descalvado, State of Sao Paulo.

14872. From Pirassununga, State of Sao Paulo. Not named, but highly esteemed in the locality.

14873. *Bussucaba.* From near the city of Sao Paulo, State of Sao Paulo.

14874. *Crioula.* From Santa Rita, State of Sao Paulo.

14875. *Fumo Bahia.*

14876. *George Grande.* From the State of Rio de Janeiro.

14877. *Goyana.* Yellow, from the State of Goyaz.

14878. *Goyana.* White, from the State of Goyaz. Doctor Lane says that both the yellow and the white *Goyana* are famous thruout the country.

14879. ZEPHYRANTHES sp.

From San Luis Potosi, Mexico. Presented by Dr. Edward Palmer, thru Dr. J. N. Rose. Received June 19, 1905.

14880 and 14881. VICIA FABA. **Horse bean.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., June 22, 1905.

14880. *Printemps de Lorraine, petite.*

14881. *D'Hiver.*

14882. ZIZYPHUS sp. (?).

From Bulsar, India. Presented by Rev. W. R. Miller, 466 Jackson boulevard, Chicago, Ill. Received June 23, 1905.

14883. MEDICAGO SATIVA. **Alfalfa.**

From Logan, Mont. Received thru Mr. William Carpenter, June 24, 1905.

14884. CINNAMOMUM CAMPHORA. **Camphor.**

From Yokohama, Japan. Received thru L. Boehmer & Co., June 24, 1905.

14885 to 14887. GOSSYPIUM spp. **Cotton.**

From Sydney, New South Wales, Australia. Received thru Mr. J. H. Maiden, director of the Botanic Garden, July 7, 1905.

Cotton seed and samples of lint secured on request from Mr. David Thomatis, Caravonica, Cairns, North Queensland, Australia, April 21, 1905.

14885. *Caravonica I.* (Wool cotton.)

14886. *Peruvian Kidney.*

14887. *Caravonica II.* (Silk cotton.)

14888. Nephelium litchi. **Litchi.**

From Honolulu, Hawaii. Received from Mr. G. P. Wilder, thru Mr. James Mills, Arlington Heights Fruit Company, Riverside, Cal., July 10, 1905.

"The tree which bore these fruits is one of the two or three mature trees of this species in Hawaii and is the property of Mrs. Afong. The price of these fruits is about 3 cents each on the retail market of Honolulu. Seeds from Mrs. Afong's trees are being extensively planted in the islands; the demand is likely to be much greater than the supply for many years. It is believed the variety comes fairly true from seed, but in China, where about six distinct sorts are recognized, grafting or inarching is relied upon for best results.

"The yellowish, sweet, pulpy arillus of this fruit is highly esteemed in China, Cochin China, and the Philippines. It also fruits in East Australia, and it can undoubtedly be grown with profit in Porto Rico, south Florida, and California.

"The fruit resembles a strawberry or large acorn in size and shape but has a shell-like, rough skin; the pulp is white, very juicy, and of a peculiar sweet and sour flavor, the taste for which does not have to be acquired." (*Wilder.*)

14889 and 14890. Persea gratissima. **Avocado.**

From City of Mexico, Mexico. Presented by the American ambassador. Received July 13, 1905.

14889. *Seedless.* **14890.** *Seedless Butter.*

14891. Solanum muricatum (?). **Pepino.**

From Port of Spain, Trinidad. Received thru Mr. Eugene André, July 7, 1905.

14892. (Undetermined.)

From Kongo Free State, Africa. Presented by the director of the Botanical Garden at Eala, thru the Department of Finances, Brussels, Belgium. Received July 17, 1905.

A wild ornamental recently discovered in the Kwango Oriental district of the Lower Kongo, Kongo Free State.

14893 and 14895. Solanum tuberosum. **Potato.**

From Quito, Ecuador. Presented by Mr. L. Martines, chief of the Department of Public Instruction, Section of Agriculture.

Seed potatoes.

14893. *Chola.*

From the "El Obraje" estate, Señor Luis F. López Ortega, proprietor, parish of Chillogallo, Province of Pichincha, 2,900 meters above sea level. (No. 1.)

14894. *Uchu-rumi.*

From the "Carrión" estate, Señor Carlos Mateus, proprietor, parish of Lloa, Province of Pichincha, 2,900 meters above sea level. Grown in alluvial soil. (No. 2.)

14895. *Chola.*

Grown on same estate as preceding, at the base of Pichincha volcano, 2,900 meters above sea level, in dark, heavy soil. (No. 3.)

14896 to 14906.

From Richmond, New South Wales. Presented by Mr. H. W. Potts, principal of the Hawkesbury Agricultural College. Received June 26, 1905.

14896. Andropogon affinis.
14897. Eragrostis brownii interrupta.
14898. Eragrostis leptostachya.
14899. Eragrostis pilosa.
14900. Sterculia diversifolia.
14901. Ehrharta stipoides.
14902. Panicum effusum.
14903. Panicum sanguinale.
14904. Paspalum brevifolium.
14905. Chaetochloa glauca.
14906. Stipa tuckeri.

14907. CITRUS DECUMANA. **Pomelo.**

From Oneco, Fla. Received thru Reasoner Brothers, July 3, 1905.

Stick's Tresca Red.

14908. PHYSALIS EDULIS. **Cape gooseberry.**

From Cape Town, South Africa. Presented by Prof. C. P. Lounsbury, government entomologist, Cape of Good Hope Department of Agriculture. Received June 26, 1905.

"The mother plantation is at Wynberg, here in the Cape Peninsula. The plant with us is a perennial, but the frost will cut it down. In some districts it fruits well; in others, scarcely at all. It seems to do best on the border of woodlands. A species of Tetranychus is its one great pest in South Africa. Mr. Malley tells me that his brother has tried it in Texas without success." (*Lounsbury.*)

14909 to 14921. ZEA MAYS. **Popcorn.**

From Santiago, Chile. Presented by Señor Salvador Izquierdo, Santa Ines, near Santiago. Received June 23, 1905.

"Samples of popcorn used in Chile for the manufacture of 'llalli.' Samples were without names or specific data other than the above." (*Fairchild.*)

14922. THYSANOLAENA AGROSTIS.

From Calcutta, India. Presented by A. Gage, officiating superintendent, Royal Botanic Garden, Sibpur, near Calcutta. Received June 24, 1905.

See S. P. I. No. 8445, for a description of this unusually beautiful ornamental cane.

14923 to 14944. OPUNTIA sp. **Tuna.**

From San Luis Potosi, Mexico. Received from Dr. Edward Palmer thru Dr. J. N. Rose, of the United States National Museum, June, 1905.

14923. *Pachona.*
14924. *Pasteada Lisa.*
14925. *Narancow Lisa* (spineless.)
14926. *San Juanara Manzana,* blanca.
14927. *Cameosa Lisa.*
14928. *Tuna Blanca Seca.*
14929. (No label.)
14930. *Morada.*
14931. (Spineless.)
14932. (No label.)
14933. (No label.)
14934. (No label.)
14935. (No label.)
14936. (No label.)
14937. (Doctor Rose's No. 613/05.)
14938. (Doctor Rose's No. 614/05.)
14939. *Ranchera* (Doctor Rose's No. 643/05).
14940. *Cueja* (Doctor Rose's No. 644/05).
14941. (Doctor Rose's No. 646/05.)
14942. *Camuesa Prisco* (Doctor Rose's No. 673/05).
14943. *Mansa Color de Rosa* (Doctor Rose's No. 674/05).
14944. *Crystalina Blanca* (Doctor Rose's No. 675/05).

14945 and 14946. GOSSYPIUM sp. **Cotton.**

From Payta, Peru. Received thru Duncan, Fox & Co., July 3, 1905.

14945. Brown seed.
14946. White seed.

14947. CUCURBITA MELANOSPERMA.

From San Luis Potosi, Mexico. Presented by Dr. Edward Palmer. Received June 22, 1905.

"One fruit called '*Cila callote*' from a vine that is very productive. The fruit keeps several months. Fine preserves are made from it—one from the interior after the seeds are removed, another in the ordinary way, the third a hard marmalade. If the seeds are sent to some suitable experiment station with long seasons, they will be as useful as in Mexico." (*Palmer.*)

14948. Lapageria rosea. **Chilean bellflower.**

From Coronel, Chile. Presented by Mr. Teodoro Finger, of La Compania de Aranco (Limited). Received July 3, 1905.

"The plant is a creeper, evergreen and lasting, growing up the highest trees and covering the same entirely with its foliage, and in winter the most beautiful scarlet-red big bell-like blossoms make it the favorite Chilean flower for the sight and decoration when no other flowers are blooming. It has given to the Chilean forests a peculiarly attractive and beautiful appearance, being mentioned by almost every traveler. It grows on any soil, preferring heavy red-clay soil. It requires fair watering. It always climbs up a bushy shrub or on a tree. You can sow it in spring, and it stands a light frost without danger. It is entirely an ornamental plant. The roots go down very deep and form a potato at the end, which causes the death of the plant if it is cut off at transplanting. The plants have been taken to Europe, and especially are they grown in hothouses and winter gardens in England. It has caused attention that the plants transplanted to Europe, giving once red blossoms, will never give red blossoms again, but only white ones. It is very difficult to get ripe seeds in the virgin forests, as the birds are very fond of them. The seeds are covered with a small cucumber-like and a little sourish-tasting mass, which the natives like to eat. I find no pleasant taste in them at all." (*Finger.*)

14949 to 14951. Opuntia spp. **Tuna.**

From San Luis Potosi, Mexico. Received from Dr. Edward Palmer, thru Mr. W. E. Safford, of the Bureau of Plant Industry, June, 1905.

14949. *Tapona.* Red, globular fruit.

14950. *Cardona.* Yellow fruit.

14951. (An unnamed variety; has thick, tuberculated root.)

14952 to 14962.

From Shanghai, China. Presented by Mr. Edward S. Little. Received in May, 1905.

14952. Glycine hispida. **Soy bean.**

Black.

14953. Glycine hispida. **Soy bean.**

Large yellow.

14954. Glycine hispida. **Soy bean.**

Small yellow.

14955. Panicum miliaceum. **Broom-corn millet.**

Red.

14956. Panicum miliaceum. **Broom-corn millet.**

White.

14957. Brassica chinensis. **Chinese rape.**

14958. Sesamum indicum. **Sesame.**

Black.

14959. Sesamum indicum. **Sesame.**

White.

14960. Phaseolus radiatus.? **Mung bean.**

14961. Arachis hypogaea. **Peanut.**

Small.

14962. Arachis hypogaea. **Peanut.**

Large.

14963. ORYZA SATIVA. **Rice.**

From Kobe, Japan. Presented by Mr. K. Ojuni, custom-house, Kobe, Japan. Received April 17, 1905.

14964 to 14971.

From Kashmir, India. Received thru the Office of Farm Management Investigations, July 8, 1905. Seeds collected by Messrs. Ellsworth Huntington and R. L. Barrett.

14964. HORDEUM VULGARE. **Barley.**

"Barley from Sonamarg, in the Sind Valley, Kashmir. Altitude, 8,500 feet; rainfall, probably 50 inches." (*Huntington.*)

14965. HORDEUM VULGARE. **Barley.**

Hull-less. "From Dras, in the Indus Valley, India. Altitude, 10,100 feet; rainfall, probably about 30 inches, mostly as snow. Irrigation is practised. Snow was 6 feet deep April 13, and lasts till well into May." (*Huntington.*)

14966. LATHYRUS sp.

From Dras, in the Indus Valley, India.

14967. ORYZA SATIVA. **Rice.**

"From Kund, in the Sind Valley, Kashmir, India. Elevation, 6,800 feet. The climate of this region is so severe that on April 7, 1905, after an unusually hard winter, the ground was still well covered with snow. The rainfall of the region is perhaps 40 to 50 inches, well distributed thruout the year." (*Huntington.*)

14968. PANICUM MILIACEUM. **Broom-corn millet.**

"From Kulan in the Sind Valley, Kashmir, India. Altitude, 7,200 feet. Precipitation, about 40 inches. Snow lasts till April." (*Huntington.*)

14969. FAGOPYRUM TATARICUM. **Buckwheat.**

"Hindustani '*trumba*,' from Kund, in the Sind Valley, Kashmir, India. Altitude, 6,800 feet. The climate of this region is such that on April 7, 1905, after an unusually severe winter, the ground was still well covered with snow. This grain is said to make good bread, tho slightly bitter. The rainfall of the region is perhaps 40 inches or more, well distributed thruout the year." (*Huntington.*)

14970. TRITICUM VULGARE. **Wheat.**

"From Tashgam, Indus Valley, India. Rainfall from 25 to 30 inches, mostly as snow. Irrigation necessary. Snow lasts till middle of April." (*Huntington.*)

14971. ZEA MAYS. **Corn.**

"From Kund, in the Sind Valley, Kashmir, India. Altitude, 6,800 feet. The rainfall of the region is perhaps 40 to 50 inches, well distributed thruout the year. The climate of this region is such that on April 7, 1905, after an unusually severe winter, the ground was still covered with snow." (*Huntington.*)

14972 and 14973.

From Quito, Ecuador. Presented by L. Martines, chief of the Department of Public Instruction, Section of Agriculture. Received July 13, 1905.

14972. MEDICAGO SATIVA. **Alfalfa.**

From Guanando district, Province of Chimborazo, 2,400 meters above sea level.

14973. SOLANUM TUBEROSUM. **Potato.**

Chauca. White and black. Early variety from Hacienda Magdalena, Province of Imbabura, 2,225 meters above sea level.

14974 and 14975.

From Sao Paulo, Brazil. Presented by Dr. H. M. Lane, July 25, 1905.

14974. PHASEOLUS LUNATUS. **Lima bean.**

Grown in Batataes. Doctor Lane says that these are the most wonderfully prolific pole beans he ever saw.

14975. NICOTIANA TABACUM. **Tobacco.**

Seed from Goyaz. Doctor Lane is afraid it is a mixt lot, as the friend who sent it wrote: "It contains the best varieties grown in the State. The *White*, *Yellow*, and *Giant* can easily be distinguished in the plants."

14976 to 14979. NICOTIANA TABACUM. Tobacco.

From Cachoeira, Bahia, Brazil. Received from Mr. W. A. Waddell, July 28, 1905. Sent at the request of Dr. H. M. Lane, of Sao Paulo.

14976. Seed from Santa Estevao.

14977. Seed from Outeiro Redendo.

14978. Seed from Cabeças de Murityba.

14979. Seed from Cruz das Almas.

14980 to 14983. OPUNTIA spp. Prickly pear.

From Tunis, North Africa. Received thru the director of the Tunisian Department of Agriculture and Commerce, July 28, 1905.

14980. OPUNTIA FICUS-INDICA.

14981. OPUNTIA TUNA.

14982. OPUNTIA FICUS-INDICA INERMIS.

14983. OPUNTIA ROBUSTA.

14984 to 14989.

From Cape Town, South Africa. Received thru the Smithsonian Institution, from Mr. H. J. Chalvin, superintendent of the Municipal Gardens, July 29, 1905.

14984. ASPARAGUS CRISPUS.

14985. FREESIA REFRACTA ALBA.

14986. SPARAXIS BULBIFERA.

14987. SPARAXIS PURPUREA.

14988. SYNNOTIA BICOLOR.

14989. TRITONIA FENESTRATA.

14990 and 14991.

From Paris, France. Received thru Vilmorin-Andrieux & Co., August 10, 1905.

14990. VICIA VILLOSA. **Hairy vetch.**

14991. HEDYSARUM CORONARIUM. **Sulla.**

14992. ZEA MAYS. Popcorn.

From Amboina, Dutch East Indies. Presented by Mr. Roskott. Received August 9, 1905.

14993. CITRUS AUSTRALASICA. Finger lime.

From Queensland, Australia. Presented to Prof. W. M. Hays, St. Anthony Park, Minn., by Mr. James Pink, of Wellington Point, near Brisbane. Received August 11, 1905,

"It is a fruit which I think capable of great improvement. Nothing has ever been attempted with it here, and I send you a few dried fruits which, I have no doubt, contain good seeds. The plant is a large shrub, very limited in its distribution.

"The fruit when well grown is from 3 to 4 inches long, of a bright orange-crimson color, and of excellent flavor." (*Pink.*)

14994. TRIFOLIUM INCARNATUM. Crimson clover.

From New York, N. Y. Received thru Henry Nungesser & Co., August 11, 1905.

14995. DAHLIA IMPERIALIS. **Dahlia.**

From Queenstown, Cape Colony. Received thru Mr. F. Beswick, secretary of the Queenstown Public Gardens, August 14, 1905.

14996 to 14998.

From Mexico. Received thru Dr. J. N. Rose, of the United States Nationa Museum, August 14, 1905.

14996. SCHOENOCAULON sp.

14997. JUGLANS sp.

14998. PINGUICULA sp.

14999. EUPATORIUM PORTORICENSE. **"Guerrero."**

From Mayaguez, P. R. Received thru Mr. O. W. Barrett, from the Agricultural Experiment Station, August 15, 1905.

"A shrub, 1 to 3 meters high, found in a semicultivated state in the western part of Porto Rico. The dried leaves have a strong vanilla-like fragrance and are used in scenting the better grades of Porto Rican tobacco. Tho a perennial, this plant will probably fruit in the latitude of Connecticut; it is a very rapid grower." (*Barrett.*)

15000 to 15210. PHOENIX DACTYLIFERA. **Date.**

From Tunis, North Africa. Received thru Mr. Thomas H. Kearney, agricultural explorer, who secured them during his explorations in the winter of 1904–5 in the oases of southern Tunis.

"The nomenclature is that secured by Mr. Kearney from the Arabs from whom he bought the suckers, and the descriptions were made partly in Tunis and partly after his return to this country. See his bulletin on the date palms of Tunis." (*Fairchild.*)

15000. *Ammary.*

A third-class "soft" variety; fruit 1¼ to a little over 1½ inches long, about one-half as wide, generally obovoid, square at the base, rounded at the apex, keeping its shape fairly well when preserved, dark-brown purple when ripe; the flesh 1½ lines thick, very soft and dark colored; the seed about two-thirds as long as the fruit, about two-fifths as wide as long, blunt at both ends. The stalks and branches of the fruit clusters are orange colored.

The earliest maturing variety in Tunis, ripening in August and September. Said to give a very good crop every year and to be very productive.

15001. *Angoo.*

A second-class "dry" variety; fruit barely 1 inch long, about seven-tenths as wide, sometimes broadest below, sometimes above the middle; bright bay-colored when ripe, much of the skin becoming loosened in large blisters, the flesh a little over 1 line thick, becoming firm and dry, the white central portion thicker than the dark-colored outer zone; the seed about two-thirds as long as the fruit, about one-half as wide as long, light-drab brown. The stalks of the fruit clusters are lemon yellow.

The smallest fruited of the Tunisian varieties. Despite its diminutive size and thin flesh, this little date is one of the most attractive of the "dry" type. Because of its moderately sweet, wholesome, nutty flavor it can be eaten in large quantities without cloying, and should be a healthful food. Ripens in midseason.

15002. *Areshty.*

A first-class "soft" variety; fruit 1⅔ to 2½ inches long, one-half to two-thirds as wide, slightly larger above than below the middle, broad and rounded at the apex, light bay or hazel brown when ripe; the flesh 2½ to 3 lines thick, firm but tender; the seed about one-half as long as the fruit, rather thick, irregularly roughened. The stalks and branches of the fruit clusters are light orange. The foliage of this variety is rather light and the leaves drooping.

One of the largest dates grown in Tunis. The fruit is generally egg-shaped, ripening about the middle of October. The flavor of the thoroly ripe fruit is agreeable, altho not very remarkable, wholesome, nut-like, and not easily cloying. The flesh becomes quite firm and the ripe fruit keeps its shape well when preserved.

15000 to 15210—Continued.

15003. *Baydh Hammam.*

A second-class "soft" variety; fruit 1⅔ to 1¾ inches long, three-eighths to five-eighths as wide, egg-shaped, broadest near the middle, rather conspicuously blunt-pointed at apex, not keeping its shape well, dark chestnut brown with a tinge of maroon when ripe; the flesh very soft and dark colored, about 2 lines thick; the seed one-half to five-eighths as long as the fruit, one-third to two-fifths as wide as long; dark brown. The stalks and branches of the fruit clusters are orange colored. The foliage is of a rather delicate aspect and the leaves numerous.

This is a handsome, dark-brown date with very soft, dark-colored flesh. It is always eaten fresh, not being conservable. It is exceedingly sweet. The flavor of the perfectly ripe fruit is agreeable and very characteristic. It ripens rather late, hardly before November.

15004. *Bayjoo*, or *Badjou.*

A third-class "dry" date; fruit 1⅓ inches long, about two-thirds as wide, ovoid, purplish maroon or bay colored when ripe; the flesh 1½ lines thick; the seed nearly two-thirds as long as the fruit, one-half as wide as long; light brown. The stalks and branches of the fruit clusters are pale orange colored. The small, dense bunches of fruit hang down on long curved stalks.

Flavor nutty, agreeable but not very characteristic, typical of the "dry" date class. Matures in October.

15005. *Bent Segny.*

A third-class "soft" variety; fruit 1¾ to 1⅞ inches long, about one-half as wide, obovoid, square at base, rounded at apex, keeping its shape poorly when preserved, very dark purplish brown (almost black) when ripe; the flesh 1½ lines thick, very dark colored and very soft; the seed about one-half as long as the fruit, two-fifths to one-half as wide as long, rounded at both ends. The stalks and branches of the fruit clusters are deep orange colored.

A very soft, sirupy date, with a pleasant but not remarkable flavor. Ripens about the end of October.

15006. *Besser Haloo*, or *Bisra Haloua.*

A second-class "soft" variety; fruit 1⅓ to 1½ inches long, about two-thirds as wide, broadest at or above the middle, rounded at the apex, keeping its shape well when ripe, bright bay colored; the flesh 2 lines thick, comparatively dry when the fruit is ripe, light brown; the seed two-thirds to three-fourths as long as the fruit, generally two-fifths as wide as long, with more or less conspicuous winglike ridges on the sides. The spreading or ascending stalks of the fruit clusters are so short that the small bunches are nearly hidden by the foliage. The leaves are short and rather stiff, with comparatively short stalks and wide leaflets.

A small, light-colored date, with thick, comparatively firm flesh. It is very sweet and has an agreeable flavor, somewhat intermediate between that of Lagoo and that of Horra. The natives seem to prefer it when not perfectly ripe. It matures early in October. One of the six most productive varieties. Among the four most salt-resistant varieties.

15007. *Boo Affar.*

A first-class "soft" date; fruit about 2 inches long and five-ninths to three-fifths as wide, conspicuously wider above than below the middle, but narrowed to the blunt apex, bright purplish maroon when ripe; the flesh 3 to 3½ lines thick, tender yet firm; the seeds a little more than one-half as long as the fruit, cinnamon brown. The stalks and branches of the fruit clusters are deep orange. The foliage is said to be heavy and the leaves wide and very green.

The fruit is remarkable not only for its large size, thick flesh, and delicious flavor, but for its beautiful coloring; ripens rather late. The flesh is tender, yet rather firm, and is very sweet and full of sugar. The skin, even of the ripe fruit, is fairly clean and dry.

15008. *Boo Fagoos;* also spelled *Bou Fagous*, or *Feggouss.*

A first-class date of the "soft" type; fruit 1⅔ to 1⅞ inches long, considerably more than one-half as wide, constricted near the middle and widest toward the apex, maroon to prune purple when ripe; the flesh 2½ lines thick; the seed

15000 to 15210—Continued.

five-ninths to five-eighths as long as the fruit, rather slender. The orange-colored stalks of the fruit clusters are sharply curved, and so short that the rather small bunches hardly extend beyond the leafstalks.

The foliage of this, as of several other of the finest varieties, is of a light and delicate aspect, due in this case to the relatively few leaves and the narrowness of the leaflets. The leaves themselves are large and wide, curving downward very noticeably.

The large fruit is remarkable for its unusual shape, somewhat like that of a fiddle or of some of the varieties of gherkins, to which it doubtless owes its Arabic name. The flesh is thick and rather firm, yet tender. It is very sweet and has a very distinctive and highly attractive flavor. It ripens late in October.

15009. *Deglet Barca.*

Fruit said to be "soft," round, and nearly black. It is described as a soft date that preserves very well.

15010. *Deglet Caid.*

Fruit coral red before maturity, and black when ripe; said to be conservable only for a short time. Reported to be a fine variety and to ripen early in September.

15011 and 15012. *Deglet Noor.*

A first-class "soft" date; fruit 1⅓ to a little over 2 inches long and about one-half as wide, ovoid oblong in shape, generally widest at or near the middle and blunt pointed at the apex, often narrowed also at the base, maroon colored when ripe; the flesh 2 to 3 lines thick, translucent; the seed about five-ninths as long as the fruit, conspicuously pointed, and dark chestnut brown in color. The stalks and branches of the fruit clusters are bright yellow (not orange), with stalks long and slender, sharply curved near the base, so that the bunches hang down far below the crown of foliage.

The Deglet Noor presents a combination of characteristics—fine flavor, sweetness, attractive appearance, cleanliness, good keeping qualities—that can be rivaled by no other variety that is widely grown. It requires a high sum total of temperature to bring it to perfect maturity; begins to ripen in quantity toward the end of October, slower in coming into full bearing than most varieties, the palms generally not giving a good crop until they are 10 years old, producing largely only every second or third year.

15013. *Deglet Sennaga.*

A "soft" date; fruit 37.5 to 40 mm. long, 17.5 mm. wide, oblong, somewhat pointed at the apex, bright chestnut brown when ripe, surface shining, skin much loosened and folded; flesh soft, dark colored; seed large, dark brown; very sweet; flavor distinctive (suggesting burnt sugar) and rather agreeable, but not very pronounced. It is said to keep well.

15014. *Dokar.* (Early, male.)

15015. *Dokar.* (Medium, male.)

15016. *Dokar.* (Late, male.)

15017. *Doonga*, or *Denanga.*

A second-class "soft" date; fruit a little over 1½ inches long, six-tenths to seven-tenths as wide, egg-shaped, broadest near the base, dull dark purplish maroon when ripe; the flesh 1½ to 2 lines thick, firm white, central portion nearly as thick as the dark outer zone; seeds small and thick (only about one-half as long as the fruit and about one-half as wide as long), narrowed at both ends. The stalks and branches of the fruit clusters are light orange.

A dark-colored, rather small date, with moderately soft, dark-colored flesh and with a clean, dry skin. It is very sweet and of a fine flavor, suggesting that of Deglet Noor.

15018. *Fteemy*, or *Ftimi.*

A first-class "soft" date; fruit 1⅔ to 2 inches long, about one-half as wide, oblong, slightly narrowed at both ends, dark purplish maroon when ripe, the surface shining, the flesh soft and sirupy, about 2 lines thick, the seed about

15000 to 15210—Continued.

five-ninths as long as the fruit, slender. The foliage is luxuriant, and the numerous leaves are long, wide, and crowded with long, broad leaflets. In color they are decidedly bluish, owing to the presence of a heavy, white bloom.

Altho inferior in flavor to the Deglet Noor this is unquestionably an excellent variety, greatly excelling the Deglet Noor in vigor, rapid growth, early productiveness, and large yields. The oblong fruit, when ripe, is of fine reddish purple color, very rich in flavor, extremely sweet, and so soft and sirupy as to melt in the mouth when fresh. It can not be eaten in great quantity, however, without cloying. It becomes very sticky and is therefore less satisfactory as a dessert fruit than the Deglet Noor. This variety is considered one of the most productive, giving a good crop every year. Is a late ripening variety, its fruit beginning to mature in quantity at the same time as the Deglet Noor, about November 1. It ranks among the four most alkali-resistant varieties.

15019. *Gasby.*

A third-class "soft" variety; fruit 1⅞ to a little over 2 inches long, about two-fifths as wide, oblong, often conspicuously curved, very dark prune purple, with a conspicuous bloom when ripe, the surface dull, the skin rather tough, russet brown where loosened from the flesh; the flesh 1 line thick, dark colored, remaining rather soft; the slender seed five-ninths to three-fifths as long as the fruit, two-sevenths to one-third as wide as long, russet brown, often curved. The stalks and branches of the fruit clusters are deep orange colored.

Ripens very early. A handsome, long, dark-colored, generally curved date. Flavor is of the Lagoo type, rather attractive, suggesting that of raisins. It is said to keep very well.

15020. *Gasb Haloo.*

Fruit said to resemble Kenteeshy in color; described as sweeter and better flavored than Gasby.

15021. *Guern-el-Rhezal.*

Said to be a long, slender, curved date, with a stone unusually large and a thin flesh.

15022. *Goondy.*

A third-class "soft" variety; fruit about 1⅔ inches long, about one-half as wide, obovoid-oblong, keeping its shape fairly well when preserved, bay to maroon colored when ripe; the flesh about 1½ lines thick, dark colored, remaining rather soft, the seed five-eighths as long as the fruit, about one-third as wide as long. The stalks and branches of the fruit clusters are bright orange colored. Said to ripen as early as September 15.

Sweet and agreeable, but not of pronounced flavor; of the Lagoo type.

15023. *Holooa Bayda;* also *Halouaia.*

A second-class "dry" date; fruit 1⅓ to 1½ inches long, about one-half as wide, elliptical in outline, not conspicuously narrowed at the apex, widest near the middle, dull purplish bay when ripe; the flesh 1 to 1½ lines thick, becoming very firm and dry; the seed about seven-tenths as long as the fruit and one-third to two-fifths as wide as long. The branches of the fruit clusters are pale orange.

Much like the Lemsy, but the fruit is even smaller. It ripens rather early and is generally eaten fresh, becoming hard and dry when preserved.

15024. *Halouaia.*

15025. *Hamra,* or *Hamraia.*

A third-class "dry" date; fruit 1¼ to 2 inches long, about one-half as wide, ovoid, tapering from near the base to the rounded apex, bright purplish maroon when ripe; the flesh 1 to 3 lines thick, becoming quite firm, the dark-colored outer zone thicker than the white central portion; the seed two-thirds to four-fifths as long as the fruit, generally about two-fifths as wide as long, sometimes with strongly developed winglike ridges on the sides. The stalks and branches of the fruit clusters are orange colored.

One of the largest and most showy of the "dry" dates. Much resembles Horra

15000 to 15210—Continued.

and surpasses it in brightness of color, but is decidedly inferior to it in flavor. Ripens in the latter part of October and the beginning of November. Said to keep well.

15026. *Horra.*

The name is also spelled "Hourra," "Harra," and "Herra."

A first-class "dry" date; fruit about 2 inches long, about one-half as wide, ovate, narrowed from the base to the rounded apex, rather dull purplish maroon when ripe, the flesh 2 to 2½ lines thick, with its white central zone much thicker than the dark outer portion, the seed usually about one-half as long as the fruit. The stalks and branches of the fruit clusters are orange yellow. The leaves are large, with very numerous slender leaflets.

The fruit is the largest and finest produced by any variety of the "dry" class. The flesh becomes quite solid in the ripe fruit, but is never extremely hard and dry. It has the characteristic nutty flavor of the dry dates, but is much richer than most of them. It is at its best only when perfectly mature and is one of the best keeping varieties. A medium-early sort, ripening in October.

15027. *Iteema,* or *Ytima.*

A third-class "soft" variety; fruit slightly over 2 inches long, about one-half as wide, widest at or near the middle, rounded at the base, somewhat pointed and conspicuously unsymmetrical at apex, not keeping its shape well when preserved, chestnut brown, with a slight purple tinge when ripe, the surface shining, the flesh over 2 lines thick, extremely soft, the seed nearly one-half as long as the fruit, about two-fifths as wide as long, chestnut colored.

A very handsome date, with sirupy, translucent flesh, extremely sweet, rather insipid in flavor. Early ripening sort. Is eaten fresh.

15028. *Karooy.*

A third-class "soft" variety; fruit 1⅔ inches long, about one-half as wide, ovoid, narrowed from near the base to the rounded apex, keeping its shape fairly well when preserved, bay colored when ripe; skin, where loose, olive brown; the flesh about 1½ lines thick, rather tough; the seed about five-eighths as long as the fruit, about one-third as wide as long. The branches and stalks of the fruit clusters are orange colored.

Flesh rather tough, moderately sweet, flavor agreeable, similar to that of the "dry" dates.

15029. *Kenta.*

A first-class "dry" date, fruit 1⅓ to 1⅔ inches long, about one-half as wide, narrowed from the middle or above it to the broad apex, dull bay colored when ripe, much of the skin loosened in large blisters in the ripe fruit, the flesh 1½ to 2 lines thick, the seed four-sevenths to five-eighths as long as the fruit, rounded at both ends, light brown.

The leaves of this variety are rather broad, with numerous long, narrow leaflets. The light-orange stalks of the fruit clusters are stout and horizontal or ascending, and so short that with the bunches they do not equal the leafstalks. The clusters themselves are short, thick, and densely crowded with fruit.

One of the most highly esteemed and widely grown of the dry dates found in Tunis. The fruit is of medium size, the flesh rather thin, becoming quite firm, altho not very dry. The surface is clean and dry even when the fruit is quite ripe. It is not sirupy, altho pleasantly sweet, and can be eaten in quantity without cloying. The flavor is very agreeable, wholesome, and of the nutty quality characteristic of most dry dates. One of the best of the dry dates in keeping quality. Is a comparatively early-ripening variety, maturing about the middle of October and perhaps earlier. One of the two most productive varieties, said to give an abundant crop every year. Said to be the most salt-resistant variety in high-lying, well-drained land.

15030. *Kenteeshy,* or *Kentichi.*

A third-class "dry" variety; fruit about 1½ inches long, slightly more than one-half as wide, oblong or slightly obovoid; dull bay when ripe, the skin remaining yellow; the flesh 1 to 2½ lines thick, becoming hard and dry; the

15000 to 15210—Continued.

seed about two-thirds as long as the fruit, one-third to two-fifths as wide as long, broad and rounded at both ends. The stalks and branches of the fruit clusters are dull orange. The stalks are curved, forming nearly a semicircle, but do not hang down below the foliage.

Fruit is small, thin of flesh, and becomes hard and dry almost before it has lost its astringency. It ripens toward the end of October and beginning of November. Moderately sweet and rather tasteless. Yields heavily, being one of the most productive varieties found in Tunis, and is said to give a good crop every year. Reputed to be very alkali resistant.

15031. *Khadraya.*

A "dry" date; fruit 35 to 40 mm. long, 17.5 mm. wide, oblong, narrowed at the apex, bright orange before maturity, dull light brown when ripe; seed large, light brown. Branches of fruit clusters bright orange. Very sweet, with a pleasant flavor. Ripens in October.

15032. *Khalt* (?).

15033. *Khalt Boo Fagoos.*

A "soft" date; very similar to Boo Fagoos, 42.5 mm. long, 25 mm. wide, generally more or less obovoid, maroon colored when ripe, skin much folded; flesh very firm; seed large. Branches of fruit clusters light orange.

Moderately sweet, with a fine flavor of the Horra type.

15034. *Khalt Deglaowia.*

A second-class date of the "soft" type; fruit $1\frac{2}{3}$ to $1\frac{3}{4}$ inches long, about one-half as wide, egg-shaped, narrowed from about the middle to the rounded apex, keeping its shape well when preserved, dark maroon purple when ripe, much of the skin loosened into soft blisters; the flesh about 2 lines thick, firm yet tender; the seed about two-fifths as long as the fruit, about one-third as wide as long, cinnamon brown. The stalks and branches of the fruit clusters are light yellow.

The fruit is rather small, with fairly thick, firm flesh. The fine flavor suggests that of Deglet Noor, which it resembles also in the shape of the fruit and the maize-yellow color of the branches of the clusters.

15035. *Khalt Gama.*

"Gama" means wheat, and is said to refer to the color of the fruit.

15036. *Khalt Hameed.*

A third-class "soft" variety; fruit $1\frac{2}{3}$ inches long, about one-half as wide, ellipsoidal, generally slightly narrowed at both ends, keeping its shape well when preserved, bright maroon when ripe; the flesh $1\frac{1}{2}$ lines thick, rather firm, not very sugary; the seed smooth, five-eighths as long as the fruit, about two-fifths as wide as long, widest above the middle.

15037. *Khalt Harraowia.*

A second-class "soft" date; fruit $1\frac{7}{8}$ to over 2 inches long, narrowed from near the base to the somewhat pointed apex, keeping its shape well when preserved, dark-maroon purple when ripe; the flesh 2 to 3 lines thick, firm yet tender, very sugary; the seed one-half to five-ninths as long as the fruit, about one-third as wide as long. The branches of the fruit clusters are orange colored. The crown of foliage is well developed, the leaves large, and the leaflets long and numerous.

The large, handsome fruit somewhat resembles that of Horra, both in appearance and flavor. The flesh is copious, firm yet tender, and contains a great deal of sugar.

15038. *Khalt Kebeer.*

A fine, large, reddish brown "soft" date, with small seed, preserving admirably; flavor excellent.

15039. *Khalt Kentaowia.*

Occurs in the Jerid; apparently not uncommon at Tozer.

15000 to 15210—Continued.

15040 *Khalt Mooashem.*

A second-class "soft" date; fruit 1⅔ to 1⅞ inches long, about one-half as wide, egg-shaped, narrowed from about the middle to the rounded apex, keeping its shape perfectly when preserved; dark prune purple when ripe, the skin mostly adhering very closely to the flesh, conspicuously marked with transverse and longitudinal scars; the flesh about 2 lines thick, firm yet tender; the seed about one-half as long as the fruit, nearly one-half as wide as long, broadest near the middle, light brown, rough. The branches of the fruit clusters are bright orange.

The excellent fruit is characterized by its dark prune color, curiously scarred skin, copious soft flesh, and very sweet, highly attractive flavor. Apparently keeps perfectly.

15041. *Kharooby*, or *Kharroubi.*

A third-class "soft" variety; fruit about 2 inches long, less than two-fifths as wide, oblong, often somewhat wider near the apex than elsewhere, between bay and maroon colored when ripe, the surface shining; the skin conspicuously loosened and remaining light yellow; the flesh 1 to 2 lines thick, rather soft and dark colored; the seed nearly three-fifths as long as the fruit, one-third as wide as long, generally somewhat curved. The stalks and branches of the fruit clusters are orange colored.

Flesh of the ripe fruit of the consistency of jelly, moderately sweet, agreeable in flavor, resembling Lagoo. Said to preserve well. Ripens in October.

15042. *Kseba*, or (?) *Kessebi.*

A second-class "dry" variety; fruit about 1½ inches long, two-thirds as wide, ovoid or oblong-ovoid, widest below the middle, purplish maroon or bay when ripe; the flesh 2 to 2½ lines thick, firm but tender; the seed very nearly two-thirds as long as the fruit, two-fifths as wide as long, russet brown. The branches of the fruit clusters are deep orange. The foliage is characterized by having few spines and these are slender and weak.

The fruit, which preserves well, is very sweet and well flavored, in the latter respect being intermediate between Horra and Lagoo. Its fruits ripen in October.

15043. *Lagoo.*

A second-class "soft" date; fruit nearly 2 inches long, four-ninths as wide, oblong, tapering slightly to the apex, more or less curved, bay to light maroon colored when ripe, the surface somewhat shining; the flesh about 2 lines thick, rather tough, dark colored; the seeds slender, three-fifths to two-thirds as long as the fruit, two-sevenths to one-third as wide as long, russet brown, its surface roughened with fine wrinkles. The stalks and branches of the fruit clusters are orange colored, the crown of foliage is rather small, the leaves short and rather thick, with long, rather wide leaflets.

One of the earliest kinds; said to ripen by the middle of September. The fruit is of medium length, narrow, and dark colored when ripe. The flesh is rather thin, but soft, very sweet, and of an agreeable, characteristic flavor, somewhat resembling Rhars. It keeps well.

15044. *Lemsy.*

A second-class "dry" date; fruit 1½ to 1⅔ inches long, about one-half as wide, elliptical in outline, not conspicuously narrowed toward the apex, often slightly curved, dull purplish maroon when ripe; the flesh 1 to 2 lines thick, becoming very firm and dry; the seed about two-thirds as long as the fruit, generally one-third as wide as long. The branches of the fruit clusters are orange colored.

This is a small, thin-fleshed dry date, sometimes preserved, but usually eaten fresh and even before it is perfectly ripe, as the flesh soon becomes dry and hard. It is deliciously sweet and has a fine flavor, tasting somewhat like chestnuts. Said to mature at the end of August.

15045. *Menakher.*

A first-class date of the "soft" type; fruit 2 to 2⅓ inches long, about one-half as wide, oblong, broad, and rounded at both ends, keeping its shape well when preserved; brownish maroon when ripe; the flesh 2 to 2½ lines thick;

15000 to 15210—Continued.

the seed broad at both ends, about one-half as long as the fruit, one-half as wide as long, very rough.

The leaves are long and broad, and rather stiff and heavy, crowded with very numerous long leaflets, and their stalks are armed almost thruout their length with long, stout spines. The fruit clusters are short and dense, their stalks bright yellow, rather short, stout, and only moderately curved, so that the bundles do not hang down below the leaves as in the Deglet Noor, but are almost hidden by the foliage.

This produces fruit that is thought by many of the natives, and even by some of the few Europeans who have tasted it, to surpass the Deglet Noor; is at least equal in quality to the Deglet Noor, which it considerably resembles in flavor. In size Menakher dates are 1½ to nearly 2 times as large as those of the Deglet Noor variety; in color they are generally darker. The seed, tho thick, is short in proportion to the length of the fruit. It is very different in appearance from that of the Deglet Noor. The thick, translucent flesh, altho soft and sirupy, becomes firm when preserved, just as does that of the Deglet Noor. If preserved with any care Menakher dates keep their shape admirably. The skin does not become sticky but remains dry and clean, which is a very desirable property in a dessert fruit. An objectionable feature is the strong development of the white, stringy core. This diminishes perceptibly, however, in thoroly ripe fruit. The consensus of opinion is that in point of appearance, cleanness of skin, keeping quality, and delicacy of flavor the Menakher dates surpass the Deglet Noor, while the latter are superior in the crisper texture of the flesh and small development of the stringy core, or "rag."

This variety ripens its fruits in the latter part of October. It is said to yield little during the first few years after the offshoots are planted, but afterwards surpasses the Deglet Noor in yield, one palm producing sometimes 220 pounds of dates.

15046. *Mokh Begry*, or *Moukh Begri.*

A second-class "soft" variety; fruit 1⅓ to 1½ inches long, about three-fourths as wide, broadest at the base, and narrowed thence to the broad, rounded apex, flattened on the sides, bright bay colored when ripe; the flesh very soft, about 1½ lines thick, rather dark colored, translucent; the seed light brown, one-half to two-thirds as long as the fruit, about twice as long as wide, rounded at both ends. The stalks and branches of the fruit clusters are light orange.

The trees are said not to bear heavily. The dates are rather small and have an unusual shape. The translucent flesh is very soft, but the fruit is said to preserve well. It is very sweet and of delicious flavor, resembling and perhaps equaling the Deglet Noor. Fruit ripens in the latter part of October.

15047. *Okht Ammary.*

Said to resemble Ammary, but to be larger. Reported to ripen at the end of September and not to keep well.

15048. *Okht Fteemy.* (French, *Oukht Ftimi.*)

A second-class "soft" date; fruit 2 to 2⅙ inches long, about two-fifths as wide, oblong, straight, somewhat pointed at the apex, deep purplish maroon when ripe, the surface shining; the flesh 2½ to 3 lines thick, soft; the seed slender, about one-half as long as the fruit, only two-sevenths as wide as long; dark brown. The stalks and branches of the fruit clusters are rich orange. The many fruit clusters are short-stalked and almost hidden by the foliage.

The very handsome fruit is longer and more slender than that of Fteemy, and is often brighter colored, but is otherwise very similar. In regard to flavor, no difference could be detected. Altho very soft and sirupy, the fruits preserve well. Okht Fteemy palms give a good crop every year and are very productive. These dates are not generally ripe before November. Among the most alkali-resistant varieties.

15049. *Remta.*

A third-class "dry" date; fruit 1½ to 1⅔ inches long, about one-half as wide, oblong, somewhat pointed at the apex, generally distinctly constricted a little above the base, dark maroon colored when ripe; the flesh about 1 line thick, rather tough; the seed one-half to two-thirds as long as the fruit,

15000 to 15210—Continued.

a little less than one-half as wide as long. The stalks and branches of the fruit clusters are bright orange.

Flesh firm, moderately sweet, with an agreeable flavor resembling that of Thaby. Said to ripen early.

15050. *Rhars.* (Sometimes known as *Rhars* (or *Ghars* or *Cheress*) *Mettigui.*)

A second-class tho well-known date of the "soft" type; fruit 1⅔ to over 2 inches long, two-fifths to four-ninths as wide, oblong or inversely egg-shaped, bay colored when ripe, its surface somewhat shining; the flesh 2 to 4 lines thick, very soft; the slender seed five-eighths to three-fifths as long as the fruit, two-sevenths to one-third as wide as long, broad and rounded at both ends. The ripe fruit does not keep its shape well when preserved. The stalks and branches of the fruit clusters are bright orange. The trunk is stout and the foliage luxuriant, numerous long leaves being crowded with long, broad leaflets.

One of the earliest. Said to begin to ripen as early as the end of July. The fruit is large, bay colored when ripe, with copious soft, sirupy, translucent flesh, very sweet and rich-flavored. Not one of the best-keeping sorts.

15051. *Sba Aroossa.*

Said to be rare and of fairly good quality. Reported to be a long, slender date, ripening in October and not keeping well.

15052. *Sayba Boo Dra.*

A third-class "soft" variety; fruit 2 to over 2½ inches long, about three-sevenths as wide, oblong, somewhat pointed at the apex, usually curved; prune purple when ripe; the surface rather dull; the flesh 3 and 3½ lines thick, rather firm; the slender seed about one-half as long as the fruit and two-sevenths to one-third as wide as long. The stalks and branches of the fruit clusters are bright orange colored.

The largest of the Tunisian varieties. Flesh thick, rather tough. Flavor agreeable, suggesting Boo Fagoos. Ripens about the end of October.

15053. *Tafazween.* (Also *Tafazaouine*, or *Tafezoween.*)

A first-class "soft" date; fruit 2 to 2⅙ inches long, about two-fifths as wide, oblong, tapering slightly from base to apex, bright bay colored when ripe; the skin conspicuously marked with short linear scars; the flesh 1½ to 2 lines thick; the slender seed about three-fifths as long as the fruit.

The handsome fruit is easily recognized by its long, narrow shape, bright-bay color, and curiously marked skin. It is said to ripen in October. The flesh is soft and translucent, like that of the Deglet Noor. It is very sweet, and of excellent flavor.

15054. *Tantaboosht*, or *Tantaboucht.*

A third-class "soft" date; fruit nearly spherical, usually somewhat wider than long, 1 to 1½ inches in greatest diameter, usually widest above the middle, slightly deprest at apex, not keeping its shape well when preserved, very dark brown purple (almost black) when ripe; the flesh 3 to 5 lines thick, very soft and dark colored; the large seed two-thirds to four-fifths as long as the fruit, one-half to two-thirds as wide as long; smooth. The stalks and branches of the fruit clusters are deep orange colored.

A date remarkable for its round shape and very soft, almost black flesh. Flavor peculiar and characteristic, even perfectly ripe fruit retaining a certain amount of astringency.

15055. *Tenaseen.* (French orthography, *Tanessin*, or *Tenassine.*)

A third-class "soft" variety; fruit 1⅔ to 1⅞ inches long, about one-half as wide, oblong, not keeping its shape well when preserved, black when ripe; the flesh very soft, nearly black; the seed five-ninths to five-eighths as long as the fruit, about one-third as wide as long, rather dark brown.

The flavor of the very sweet, soft, dark-colored flesh suggests Tozer Zaid Safra, but is more agreeable. Is said to ripen in October.

15056. *Thaby*, or *Dzhabi.*

A second-class "dry" variety; fruit 1⅔ inches long or slightly longer, about one-half as wide; oblong, often slightly constricted a little above the base, some-

15000 to 15210—Continued.

what pointed at apex; bright reddish brown when ripe; the flesh 1 to 1½ lines thick, rather tough, the dark-colored outer zone apparently much thicker than the white inner portion. Seed about three-fifths as long as the fruit, rather slender. The stalks and branches of the fruit clusters are rich orange colored.

It is one of the handsomest of the "dry" dates, and one of the most attractive when preserved, keeping perfectly its shape and its beautiful, warm reddish brown color. It has an agreeable, wholesome flavor, and can be eaten in quantity without cloying. It matures in October.

15057. *Towadant.*

Fruit said to be very large and long, yellow, and of good flavor, ripening at the same time as Fteemy and keeping well.

15058. *Tozer Zaid Khala.*

A third-class "soft" variety; fruit 1½ to 1¾ inches long, three-fifths to two-thirds as wide; obovoid or oblong, broad and rounded at apex, not keeping its shape well when preserved; black when ripe; the flesh about 2 lines thick, very soft and sirupy, nearly black; the seed about two-fifths as long as the fruit, about two-fifths as wide as long; dark brown.

Less common than Tozer Zaid Safra, which it very closely resembles in appearance and flavor.

15059. *Tozer Zaid Safra.*

A third-class "soft" date; fruit 1½ to 1⅔ inches long, generally four-sevenths to two-thirds but sometimes only one-half as wide as long; oblong or oblong egg-shaped, widest near the middle, broad and rounded at the apex, not keeping its shape well when preserved; the flesh 1½ lines thick, extremely soft and sirupy; nearly black; the relatively large seed about one-half as long as the fruit, two-fifths to one-half as wide as long, light brown.

Flavor characteristic, much appreciated by the natives. Generally eaten fresh, but sometimes preserved for a short time. Yields heavily. Fruit ripens in the latter part of October. Said to be one of the four salt-resistant varieties.

15060. *Tronja*, or *Troundja.*

A first-class "soft" date; fruit perfectly round, or nearly so, 1½ to nearly 2 inches in greatest diameter; maroon to prune purple when ripe; the flesh 4 to 5 lines thick, very sugary yet firm; the seed very thick, six-tenths to seven-tenths as long as the fruit and about three-fifths as long as wide; much furrowed. The foliage is dense, the leaves wide, crowded with leaflets, and drooping gracefully at the ends.

The fruit, which ripens in October, is remarkable for its large size, the thickness of its flesh, and its globular shape. The short, very thick seed is also characteristic. The flesh is very firm and even somewhat tough, extremely sweet and very rich flavored, the flavor suggesting that of the Fteemy. Tronja dates can not be eaten in large quantities, as their richness soon cloys, but as a dessert fruit they are very promising.

15061. *Zrai.*

Fruit said to resemble Deglet Noor in color.

15062. *Zekry.*

A second-class "soft" date; fruit 1½ to near 1⅔ inches long, about one-half as wide, obovoid, keeping its shape fairly well when preserved, bay to maroon when ripe; the flesh about 1½ lines thick, moderately soft; the seed about four-sevenths as long as the fruit, about two-fifths as wide as long. The stalks and branches of the fruit clusters are orange colored.

When perfectly ripe the flesh, altho rather thin, is soft and very sweet. The flavor is characteristic, suggesting both chestnuts and persimmons. Said to yield heavily.

15063. *Menakher* (?).

15064. *Menakher* (?)

15065 to 15210.

One hundred and forty-six unidentified palms of Mr. Kearney's shipment, which were planted in the Date Garden at Mecca, Cal.

15211. PHOENIX DACTYLIFERA. **Date.**

From Winters, Cal. Received thru Prof. A. V. Stubenrauch in the spring of 1904. A large male date palm.

15212. PHOENIX DACTYLIFERA. **Date.**

From Pomona, Cal. Secured by Prof. A. V. Stubenrauch, from the substation at Pomona, Cal., and transplanted to the Date Garden at Mecca, Cal., in 1904 and 1905.

15213 to 15224. PHOENIX DACTYLIFERA. **Date.**

From Siwah Oasis, Egypt. Received thru Mr. H. I. Rankin, Fayum, Egypt, March 23, 1905, in New York.

A collection of date suckers secured by Mr. Rankin, who made a trip to the oasis of Siwah in February, 1905, to get them. The Arab names are those secured by Mr. Rankin.

15213. *Gazaley.*
15214. *Frahee.*
15215. *Saydy.*
15216. *Roghm Gazal.*
15217. *Kayby.*
15218. *Azawy*, or *Widy.*
15219. Male palms.
15220. *Saydy.*

"Dried dates from the Oasis of Siwah. According to Cailliaud they are the third in quality of the Siwah dates. While fresh these are packed in baskets to be exported and sold in Egypt." (*Rankin.*)

15221 to 15224. (Numbers assigned to four palms of this shipment which arrived without labels.)

15225 to 15313. PHOENIX DACTYLIFERA. **Date.**

From Bassorah, Arabia. Received thru Mr. H. P. Chalk, American consular agent, Bassorah, June 7, 1905.

A collection of 209 date suckers purchased from the Arabs by Mr. Chalk in Bassorah. The Arab names are those sent in by Mr. Chalk.

15225. *Bery.*
15226. *Helawy.*
15227. *Hevezy.*
15228. *Sayer.*
15229. *Gunamy.*
15230. *Khedrwy.*

15231 to 15313. (Numbers assigned to 83 palms which lost their labels in transit.)

15314. PHOENIX DACTYLIFERA. **Date.**

From Marseille, France. Received thru Champagne Brothers (Limited), August 5, 1905.

Deglet Noor. Seed.

15315 to 15332.

From Tokyo, Japan. Received thru J. Ikeda & Co., seed growers, Waseda, August 14, 1905.

15315 to 15320. BRASSICA RAPA. **Turnip.**

15315. *Shogoin.*
15316. *Tennoji.*
15317. *Omi-Kabu.*
15318. *Naga-Kabu.*
15319. *Hino.*
15320. *Kokabu.*

15315 to 15332—Continued.

15321 to 15332. Raphanus sp. **Radish.**

15321. *Nerima Marushiri.*

15322. *Nerima Shirihoso.*

15323. *Nerima Chiunaga Marushiri.*

15324. *Miyashige.*

15325. *Horyo.*

15326. *Extra Early Kunichi.*

15327. *Tokkuri.*

15328. *Shogoin.*

15329. *Early Sakurashima.*

15330. *Moriguchi.*

15331. *Kurama.*

15332. *Late Sakurashima.*

15333 to 15371.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, government agrostologist and botanist, Transvaal Department of Agriculture. Received August 14, 1905.

Forage grasses. The numbers in parentheses are those assigned by Professor Davy.

15333. (Natal redtop.) From Natal. (291/05)

15334. Aristida sp. From Natal. (288/05)

15335. (Native grass.) From Natal. (305/05)

15336. (Natal redtop.) From Natal. (239/05)

15337. Chloris virgata. From Natal. (290/05)

15338. Eragrostis sp. From Natal. (289/05)

15339. (Native grass.) (292/05)

15340. Chloris virgata elegans (?). (233/05)

15341. Setaria sp. (300/05)

15342. Eragrostis sp. (295/05)

15343. (Native grass.) (386/05)

15344. Setaria aurea. From Natal. (299/05)

15345. (Native grass.) (297/05)

15346. (Native grass.) (389/05)

15347. (Native grass.) (423/05)

15348. (Native grass.) (520/05)

15349. (Native grass.) (306/05)

15350. (Native grass.) (471/05)

15351. (Native grass.) (467/05)

15352. (Native grass.) (469/05)

15353. (Native grass.) (298/05)

15354. (Native grass.) (464/05)

15355. Chloris sp. (403/05)

15356. (Native grass.) (472/05)

15357. (Native grass.) (466/05)

15358. Eragrostis sp. From Natal. (289/05)

15359. Eragrostis sp. (390/05)

15360. (Native grass.) (429/05)

15361. (Native grass.) (396/05)

15362. Paspalum sp. (234/05)

15363. (Native grass.) (232/05)

15364. Eragrostis curvula valida. (307/05)

15365. (Native grass.) (425/05)

15366. Setaria sulcata. From Natal. (312/05)

15367. (Native grass.) (388/05)

15368. (Native grass.) (387/05)

15369. (Native grass.) From Natal. (315/05)

15370. (Native grass.) (308/05)

15371. (Native grass.) (296/05)

"Several of the species of Setaria and Eragrostis are valuable forage grasses. *Setaria sulcata* (S. P. I. No. 15366) is one of our best forage grasses, but requires a warm climate. It will stand some frost, however, as the roots have not been killed with a temperature of + 18° F. *Setaria aurea* (S. P. I. No. 15344) is a valuable hay grass. S. P. I. No. 15340 and S. P. I. No. 15337, forms of *Chloris virgata*, tho annual, are of great value here, making an excellent and sweet hay. This grass ought to be tried in Arizona, New Mexico, and southern California, and I am sending seed to the Arizona and California stations." (*Davy.*)

15372. COLOCASIA ANTIQUORUM ESCULENTUM. **Taro.**

From Mayaguez, P. R. Received thru Mr. H. C. Henricksen, Agricultural Experiment Station, August 15, 1905.

"This is one of the 40(?) varieties of taro cultivated in Hawaii. Roots of this variety, called *Japanese*, were sent from the Hawaiian Experiment Station to the Porto Rico Experiment Station in 1903. It does not compare favorably in Porto Rico with the Trinidad taro of the same type." (*Barrett.*)

15373. COLOCASIA ANTIQUORUM ESCULENTUM. **Taro.**

From Mayaguez, P. R. Received thru Mr. H. C. Henricksen, Agricultural Experiment Station, August 15, 1905.

"This variety is known as the *Royal* taro in Hawaii. It is one of the few true taros having purplish roots. The Porto Rico Experiment Station received this variety in 1903 from the Hawaiian Experiment Station, but it did not grow satisfactorily in the testing plats at Mayaguez, P. R." (*Barrett.*)

15374. ARRACACIA ESCULENTA. **Apio.**

From Ponce, P. R. Received thru Mr. J. W. van Leenhoff, August 15, 1905.

"Tho this plant is not cultivated in Porto Rico so widely as in Venezuela, it always sells for a good price in the local market. It grows better in elevated districts, preferring a cool, moist situation. Partial shade seems to be beneficial at low elevations. It should be treated like carrots." (*Barrett.*)

15375. PYRUS sp. **Pear.**

From Shanghai, China. Received thru Rev. J. M. W. Farnham, August 16, 1905.

15376. RUBUS sp. **Raspberry.**

From Shanghai, China. Received thru Rev. J. M. W. Farnham, August 16, 1905.

"A berry growing wild on the mountains about 150 miles southwest of Shanghai. The fruit is a little larger than the red raspberry which grows in New England, and has not quite so strong a raspberry flavor." (*Farnham.*)

15377 to 15422.

From Mayaguez, P. R. Received from Mr. H. C. Henricksen, of the Porto Rico Experiment Station, thru O. W. Barrett, August 15, 1905.

These varieties comprise a large part of the collection made by Mr. O. W. Barrett while botanist of that station.

15377. XANTHOSOMA sp. **Yautia.**

Guayamera Verde. "A dwarf yautia with pink tubers of first quality; not widely cultivated." (*Barrett.*)

15378. CALADIUM sp.

Brava. "A weed in fields. Leaves have a coppery luster. The grated yellow corm is used to kill maggots in sores on cattle." (*Barrett.*)

15379. XANTHOSOMA sp. **Yautia.**

Orqueta. "A small yautia with whitish petioles and pale leaves; the tuber is hard, yellow, and of second quality; cultivated in but few districts in Porto Rico." (*Barrett.*)

15380. XANTHOSOMA sp. **Yautia.**

"A yautia received from the Botanic Gardens, Aburi, Gold Coast, West Africa; it is apparently identical with one of the Jamaican varieties and was very probably introduced into Africa from the West Indies." (*Barrett.*)

15381. COLOCASIA sp. **Taro.**

Malanga 2. "Presented to the Porto Rico Experiment Station by Mr. E. André, of Trinidad." (*Barrett.*)

15377 to 15422—Continued.

15382. Colocasia sp. **Taro.**

Malanga. "Presented to the Porto Rico Experiment Station by Mr. E. André, of Trinidad." (*Barrett.*)

15383. Xanthosoma sp. **Yautia.**

"A yautia received from Trinidad, where it is known as the *Jamaica Tanier;* this variety, however, was not received in the collection from Jamaica." (*Barrett.*)

15384. Xanthosoma sp. **Yautia.**

"A semicultivated yautia sent from Guatemala by Mr. O. F. Cook; it appears distinct from any other known sort, but of little value as a crop." (*Barrett.*)

15385. Xanthosoma sp. **Yautia.**

Martinica. "A first-class yautia widely cultivated in Porto Rico, tho not observed in collections from other West India islands. It has the petioles blotched with rose, maroon, and cream, and the blades are dark green; the smallish tubers are oblong, yellow, and of a firm texture when cooked. Called *Quintal* and *Huevo* in some localities." (*Barrett.*)

15386. Xanthosoma sp. **Yautia.**

A first-class yautia obtained in Caracas, Venezuela, in 1903 by Mr. O. W. Barrett. "It attains a height of 5 feet and the largest tubers weigh from 1 to 2 pounds. This is a form of No. 15417 of Porto Rico, Trinidad, Belize, and Cuba; it may be considered the best of all known yautias." (*Barrett.*)

15387. Xanthosoma sp. **Yautia.**

Amarilla. "A common yautia in Porto Rico, prized for its drought-resisting and keeping qualities and highly nutritious yellow tubers; it is a small variety and very liable to fungous attacks." (*Barrett.*)

15388. Xanthosoma sp. **Yautia.**

Gengibrilla. "A second-class yautia from the Arecibo district of Porto Rico; the long, slender, pinkish tubers are of fair quality; it is one of the varieties of the peculiar flat-leaved *Manola* type." (*Barrett.*)

15389. Xanthosoma sp. **Yautia.**

Luquillo. "A yautia probably identical with No. 15417; cultivated at Cidra, P. R." (*Barrett.*)

15390. Xanthomosa sp. **Yautia.**

Islena. "A second-class yautia, not well known; it resembles No. 15388, but has short tubers and a different stooling habit. No. 32 of the Porto Rico Station's collection." (*Barrett.*)

15391. Xanthosoma sp. **Yautia.**

Malanga Amarilla. "A yautia received from the Cuban Agricultural Experiment Station; No. 5206 of said station's plant list." (*Barrett.*)

15392. Xanthosoma sp. **Yautia.**

Vino. "A dwarf yautia, widely cultivated in Porto Rico; the pink or purplish tubers are of excellent quality for table use but are not produced in sufficient quantity to be found on the market." (*Barrett.*)

15393. Xanthosoma (?) sp. **Yautia.**

Cimarrona. "An apparently undescribed species growing in ravines in Porto Rico; it flowers, but probably does not produce seed. The grated corms are used to kill maggots in sores on cattle or horses. (See No. 15378)." (*Barrett.*)

15394. Xanthomosa sp. **Yautia.**

Guayamera Colorada. "A common first-class yautia, apparently peculiar to Porto Rico; the mauve or purplish petioles and leaf veins distinguish this sort from all others except No. 15404. The elongated pink tubers are of good size and excellent quality. The leaves attain 6 feet in good soil." (*Barrett.*)

15377 to 15422—Continued.

15395. COLOCASIA sp. **Taro.**

Dasheen. A species of Colocasia, probably undescribed; brought from Trinidad in 1903 by Mr. O. W. Barrett. "This proves a most promising economic, since the tubers are ripened in six to nine months; it can be grown on a variety of soils; the yield in good soil is from 2 to 4 pounds to the hill. It resembles Nos. 15372 and 15373 in producing true tubers like a yautia instead of a large rhizome like a true taro." (*Barrett.*)

15396. XANTHOSOMA sp. **Yautia.**

White Eddoe. "Sent by Mr. E. André, Port of Spain, Trinidad." (*Barrett.*)

15397. XANTHOSOMA sp. **Yautia.**

"An excellent yautia sent by the Jamaica Department of Agriculture. (No. 2, Jamaica.)" (*Barrett.*)

15398. XANTHOSOMA sp. **Yautia.**

Amarilla. "A small Cuban yautia sent by the Estación Central Agronómica, Santiago de las Vegas, Cuba. Probably identical with No. 15387, but perhaps more resistant to fungous attacks." (*Barrett.*)

15399. XANTHOSOMA sp. **Yautia.**

Guagui. "A yautia sent by the Estacion Central Agronómica, Santiago de las Vagas, Cuba." (*Barrett.*)

15400. XANTHOSOMA sp. **Yautia.**

"A yautia identical [?] with No. 15394, but purchased from Reasoner Brothers, Oneco, Fla., as *Alocasia bataviensis.*" (*Barrett.*)

15401. XANTHOSOMA sp. **Yautia.**

"A yautia purchased from Reasoner Brothers, Oneco, Fla., as *Alocasia marshalli.* It yields a good-sized, edible tuber of the 'Rolliza' type." (*Barrett.*)

15402. XANTHOSOMA sp. **Yautia.**

Malanga Blanco. "A yautia received from the Estacion Central Agronómica, Santiago de las Vegas, Cuba." (*Barrett.*)

15403. XANTHOSOMA sp. **Yautia.**

"A fine yautia received thru the Jamaica Department of Agriculture. (No. 4, Jamaica.)" (*Barrett.*)

15404. XANTHOSOMA sp. **Yautia.**

Prieta. "A first-class yautia resembling No. 15394 as regards leaf coloring, but the tubers are orange yellow; a highly prized table variety, but not very productive." (*Barrett.*)

15405. XANTHOSOMA sp. **Yautia.**

Manola, or *Rolliza Ancha.* "A flat-leafed yautia not well known; the tuber is firm and yellow, but rather small." (*Barrett.*)

15406. XANTHOSOMA sp. **Yautia.**

"An excellent variety received from the Jamaica Department of Agriculture. (No. 5, Jamaica.)" (*Barrett.*)

15407. XANTHOSOMA sp. **Yautia.**

Punzera. "Probably identical with No. 15392." (*Barrett.*)

15408. XANTHOSOMA sp. **Yautia.**

Dominica. "A very choice variety of the *Amarilla* type, grown on the north side of Porto Rico; the tuber is in some respects the finest flavored and richest of all yautias." (*Barrett.*)

15409. XANTHOSOMA sp. **Yautia.**

"A first-class yautia received from the Jamaica Department of Agriculture. (No. 1, Jamaica.)" (*Barrett.*)

15337 to 15422—Continued.

15410. Xanthosoma sp. **Yautia.**

Isleña de Ponce. "A strong-growing yautia resembling No. 15392, but of two to three times the size. The tuber is of good flavor, pink, and is produced in fair quantity. Overstooling seems to be the principal fault of this variety." (*Barrett.*)

15411. Xanthosoma sp. **Yautia.**

Ysleña. "Received from the Estacion Central Agronómica, Santiago de las Vegas, Cuba. (No. 5207 of the Cuba station's list.)" (*Barrett.*)

15412. Xanthosoma sp. **Yautia.**

Belembe. "A wild or semicultivated yautia, probably *Xanthosoma hastifolium.* The young leaves of this species are preferred by the natives of Porto Rico for use (boiled) as a spinach. This plant flowers freely; it produces no tubers; height, 18 feet 2 inches." (*Barrett.*)

15413. Alocasia macrorhiza.

"This is semicultivated in some districts as a pig food; the large rhizomes are boiled to destroy the rhaphides." (*Barrett.*)

15414. Xanthosoma sp. **Yautia.**

Palma. "The largest of known Xanthosomas, tho of no great importance horticulturally. Urban considers this *X. violaceum*, but that species is usually considered as comprized by the purple-leaved forms, like Nos. 15394 and 15404. The nearly tuberless rhizome attains a length of 1 to 3 feet and a diameter of 3 to 6 inches. It is used for feeding pigs and poultry when boiled." (*Barrett.*)

15415. Xanthosoma sp. **Yautia.**

"A fine yautia, received from the Jamaica Department of Agriculture. (No. 6, Jamaica.)" (*Barrett.*)

15416. Xanthosoma sp. **Yautia.**

Quintal. "Probably identical with No. 15385. Named from its believed ability to produce 100 pounds of tubers per plant when very heavily fertilized. The rhizome is frequently eaten, tho not of so delicate a flavor and texture as the tubers." (*Barrett.*)

15417. Xanthosoma sp. **Yautia.**

Rolliza. "This is the best variety native to Porto Rico. It may be grown on a variety of soils. The yield is 2 to 4 pounds per hill. The tubers are of large size, white, mealy, and smooth. The rhizome is also eaten. This is undoubtedly *Xanthosoma sagittifolium* Schott. It occurs in Belize, Trinidad, and Cuba. A very similar form produces larger (?) tubers in Venezuela." (*Barrett.*)

15418. Xanthosoma sp. **Yautia.**

"A choice yautia, received from the Jamaica Department of Agriculture. (No. 3, Jamaica.)" (*Barrett.*)

15419. Xanthosoma sp. **Yautia.**

Blanca. "A second-class yautia, resembling No. 15417, but not so productive nor so early. The rhizome is poisonous, because of its content of calcium oxalate rhaphides. The tubers are more slender and rougher than those of the *Rolliza*, No. 15417." (*Barrett.*)

15420. Xanthosoma sp. **Yautia.**

"A yautia from Belize, probably identical with No. 15417." (*Barrett.*)

15421. Xanthosoma sp. **Yautia.**

"A yautia introduced into Porto Rico from Trinidad by the writer in 1903. It is very similar to No. 15417, but the tubers appear to vary slightly from yellowish white to pinkish white instead of being of the even white of *Rolliza.*" (*Barrett.*)

15422. Xanthosoma sp. **Yautia.**

Red Eddoe. Presented by Mr. E. André, Port of Spain, Trinidad. (*Barrett.*)

15423. NARCISSUS PSEUDO-NARCISSUS. **Daffodil.**

From Santa Cruz, Cal. Received thru Mr. E. Leedham, of the Leedham Bulb Company, August 16, 1905.

15424. MANGIFERA INDICA. **Mango.**

From Lucknow, India. Received thru Mr. Robert Anderson, Lansdowne, Pa., August 21, 1905.

Bombay (?).

15425 to 15427.

From Bellingham, Wash. Received thru Mr. H. E. Juenemann, of this Department, August 21, 1905.

15425. ROSA sp.

15426. ROSA sp.

15427. RUBUS SPECTABILIS.

15428 and 15429. VICIA FABA. **Horse bean.**

From Naples, Italy. Received thru Dammann & Co., August 18, 1905.

15428. *Vesce feverole des Champs.*

15429. *Vesce feverole petite.*

15430 to 15445.

From Bellingham, Wash. Received thru Mr. J. W. M. Smith, August 22, 1905.

15430 to 15434. HYACINTHUS sp.

15435 to 15440. NARCISSUS spp.

15441 and 15442. CROCUS sp.

15443 to 15445. TULIPA sp.

15446 to 15458.

From Clearbrook, Wash. Received thru Mr. George Gibbs, August 21, 1905.

15446 to 15456. NARCISSUS spp.

15457 and 15458. HYACINTHUS sp.

15459. NARCISSUS TAZETTA ALBA.

From Alameda, Cal. Received thru Mr. George Rosmarin, Encinal Nursery, August 22, 1905.

15460 to 15474. Mexican plants.

From City of Mexico, Mexico. Received from Dr. J. N. Rose, August 25, 1905.

The numbers in parentheses are those of Doctor Rose's notes, which give the exact localities where the various plants were secured.

15460. (No. 1178/05.)
15461. (No. 1179/05.)
15462. (No. 1180/05.)
15463. (No. 1182/05.)
15464. (No. 1183/05.)
15465. (No. 1184/05.)
15466. (No. 1185/05.)
15467. (No. 1186/05.)
15468. (No. 1187/05.)
15469. (No. 1188/05.)
15470. (No. 1189/05.)
15471. (No. 1190/05.)
15472. (No. 1194/05.)
15473. (No. 1202/05.)
15474. (No. 1205/05.)

15475 to 15477.

From Paris, France. Received thru Vilmorin-Andrieux & Co., August 26, 1905.

15475. CARAGANA ARBORESCENS. **Siberian pea tree.**

15476 and 15477. TRIFOLIUM INCARNATUM. **Crimson clover.**

15476. *Extra Early Red.*

15477. *Early White.*

15478. LILIUM LONGIFLORUM EXIMEUM. **Easter lily.**

Seed grown in the Department greenhouse by Mr. G. W. Oliver. Numbered September 2, 1905.

15479. LILIUM LONGIFLORUM EXIMEUM GIGANTEUM. **Lily.**

Seed grown in the Department greenhouse by Mr. G. W. Oliver. Numbered September 2, 1905.

15480 to 15583. ORYZA SATIVA. **Rice.**

From Tanga, German East Africa. Presented by Prof. Dr. A. Zimmermann, of the Kaiserliche Biologische Landwirtschaftliche Institut, Amani, in the spring of 1905.

A collection of native rice varieties. The notes are those given by Doctor Zimmermann.

15480.

From Pangani, in the hills, 700 meters high.

15481.

Plant from January to March. Grown in Pangani, Mgera, northerly; 1,000 meters high; river valley of the Luhisgura (?).

15482.

From Pangani, Mohomorra, northward of Useguha Mountains; 400 meters high.

15483.

From Pangani Buguru, west of Useguha; altitude 600 meters; river valley of Msangazi.

15484.

From Pangani Bondei; altitude 300 meters.

15485. *Busanga* mixt with *Kwindimba.*

Glumes of *Busanga* are brown yellow; of *Kwindimba*, gray white. Kernel of *Busanga* is white; of *Kwindimba*, brown. From Lindi.

15486. *Kwindimba.*

From Lindi.

15487. *Namaria.*

From Lindi. Mixt with *Kwindimba.* Glumes brown; strong thick awn; kernel white with a reddish tinge.

15488. *Mkemzuri.*

From Lindi. Slender awn, white kernel. Glumes yellow gold.

15489. *Mpnngarra.*

From Lindi. Glumes lighter than *Namaria* and *Mkemzuri.* Kernel white and large. Nos. 15485 to 15489 can be distinguished in cooking by specific odors. No one variety of soil is suitable for all conditions. In the valleys they are planted on moist or on sandy soils. In the high altitudes they are sown upon newly cleared land, but are uncertain and are dependent upon the rainfall.

15490. *Nondo.*

From Tanga district. Likes water.

15491. *Sifala.*

From Tanga district. Requires much water.

15492. *Nzurimwendo.*

From Tanga district. Requires much water.

15493. *Sona.*

From Tanga district. Requires much water.

15480 to 15583—Continued.

15494. *Ruwi.*

From Tanga district. Requires much water.

15495. *Mngoja.*

From Tanga district. Likes water.

15496. *Gundimba.*

From Mikindani.

15497. *Sungala.*

From Mikindani. Plant during December or January in black moist soil in valleys.

15498. *Ralimalia.*

From Matumbi Mariwe, in the district of Kilwa. Plant in heavy soil, giving much water and little sun. Matures in four and a half months after sowing.

15499. *Bungala.*

From Matumbi Mariwe, in the district of Kilwa. Plant in black soil, with much water and little sun. Matures in five months after sowing.

15500. *Seina.*

From Matumbi, near Mohora, in the district of Kilwa. Plant in black soil, with plenty of water and little sun. Matures in five and a half months after sowing.

15501. *Majeya Konoa.*

From Matumbi, near Kiswere, district of Kilwa. Requires good soil, much sun, and little water. Matures in three months.

15502. *Gundimba.*

From Matumbi, near Kiswere, district of Kilwa. Requires good soil, much sun, little water. Matures in three months.

15503. *Shindano.*

From Matumbi, near Kiswere, district of Kilwa. Requires good soil, much sun, little water. Matures in three months.

15504. *Ambari.*

From Tanga district. Likes water.

15505. *Mkarafun.*

From Tanga district. Likes water.

15506. *Mbenga Nonda.*

From Tanga district. Likes water.

15507. *Guniya.*

From Tanga district. Likes water.

15508. *Mounja Uniko.*

From Tanga district. Likes water.

15509. *Mchusi.*

From Tengra, near Saadani. Plant in November in sandy loam.

15510. *Majeya Fundi.*

From Tengra, near Saadani. Plant in November in sandy loam.

15511. *Majeya Fundi.*

From Tengra, near Saadani. Plant in November in sandy loam.

15512. *Kijegi.*

From Tengra, near Saadani. Plant in November in sandy loam.

15480 to 15583—Continued.

15513 to 15545.

(No data.)

15546.

Plant in wet soil. Grows after rainy season.

15547.

Inferior quality. Requires wet soil. Grows after the rainy season.

15548. *Bungala.*

Grown after rainy season in moist soil.

15549. *Kilimali, Akilimali, Halanaria, Tandika, Nyampendu, Halmilunda.*

Grown on lowlands, and with much rain will grow on the hills; from Mohora district, Rufiji.

15550. *Sena Kilbwali.*

Hill-land rice from Mohora district, Rufiji.

15551. *Sefala Bokianka Mbwego.*

Hill-land rice from Mohora district, Rufiji.

15552. *Kapora Najiza Kunywa Zarakupata Mpungamuene.*

Hill-land rice from Mohora district, Rufiji.

15553. *Bungala.*

From Mohora district, Rufiji. Lowlands.

15554. *Kaneno Kanenwa.*

From Mohora district, Rufiji. Hills and dry lowlands.

15555. *Nugengwa.*

From Mohora district, Rufiji. Lowlands, without irrigation.

15556. *Kijicho.*

From Mohora district, Rufiji; lowlands or hills.

15557. *Nyenyenyati.*

Lowlands, Mohora district, Rufiji.

15558. *Schindano.*

Wet lowlands, Mohora district, Rufiji.

15559. *Harula.*

Lowlands, Mohora district, Rufiji.

15560. *Kibaba Rupie.*

Lowlands, Mohora district, Rufiji.

15561. *Mbweke.*

Lowlands, Mohora district, Rufiji.

15562. *Manjano.*

Hills and lowlands, Mohora district, Rufiji.

15563. *Kensi.*

Lowlands, Mohora district, Rufiji.

15564. *Swala.*

Lowlands, Mohora district, Rufiji.

15565. *Kuku.*

Lowlands, Mohora district, Rufiji.

15480 to 15583—Continued.

15566. *Ngohe.*

Hills and lowlands. Becomes vigorous. Often planted at the edge of the field.

15567. *Borakupala.*

From Morogoro. Opening of the rainy season is sown in damp soil.

15568. *Meli.*

From Morogoro. Plant at the commencement of the rainy season in moist lowlands or marshy places.

15569. *Malula* and *Marura.*

From Morogoro. Plant at the commencement of the rainy season in moist lowlands or marshy ground.

15570. *Sena.*

From Morogoro. Plant in moist ground at the commencement of the rainy season.

15571. *Rufiji.*

From Mahenge. Plant in rainy season in heavy, black, wet soil. From five to six months to mature.

15572. *Rigubaza.*

From Mahenge. Plant in rainy season in heavy, moist, black soil. Matures in five to six months.

15573 to 15583.

From Mahenge. Mature in five to six months. Plant in rainy season in heavy, moist, black soil.

15573. *Sena.*
15574. *Schindano.*
15575. *Halimaria.*
15576. *Kapemba.*
15577. *Kafinda.*
15578. *Kikalati.*
15579. *Ngumbo.*
15580. *Satari.*
15581. *Funga.*
15582. *Kingano.*
15583. *Miknambe.*

15584. LILIUM LONGIFLORUM EXIMEUM GIGANTEUM. **Lily.**

Seedlings raised in the Department of Agriculture greenhouses. Numbered September 1, 1905.

15585 to 15593. NARCISSUS sp. **Narcissus.**

From Guernsey, England. Received thru W. Mauger & Son, Brookdale Nurseries, August 21, 1905.

15594 to 15654.

From Haarlem, Holland. Received thru Mr. C. G. van Tubergen, jr., Zwanenburg Nurseries, September 5, 1905.

Miscellaneous bulbs.

15594. GLADIOLUS ALATUS.
15595 to 15645. TULIPA spp.
15646 to 15654. IRIS spp.

15655. AVENA SATIVA. **Oat.**

From Sherman, Tex. Received thru Mr. W. F. Sheldon, September 5, 1905.

15656. PERSEA GRATISSIMA. **Avocado.**

From Miami, Fla. Received thru Col. G. B. Brackett, from Prof. P. H. Rolfs, September 5, 1905.

15657. Narcissus tazetta. **Narcissus.**

From Santa Cruz, Cal. Received thru T. Thompson, florist, September 5, 1905.

15658 to 15667. Narcissus spp. **Narcissus.**

From Leyden, Holland. Received thru De Graaf Brothers (Limited), wholesale bulb growers, September 6, 1905.

15668 and 15669.

From Chicago, Ill. Received thru the A. Dickinson Co., September 6, 1905.

15668. Dactylis glomerata. **Orchard grass.**

15669. Phleum pratense. **Timothy.**

15670 to 15672.

From Budapest, Hungary. Received thru Mr. Frank Benton, of the Bureau of Entomology, September 7, 1905.

15670. Cucurbita sp. **Squash.**

"Large, green, very warty squash. Odd looking. Flesh yellow. Seed taken from squash on sale in market of Venice, Italy, August, 1905." (*Benton.*)

15671. Cucurbita sp. **Squash.**

"Small, grayish-green, flat squash on sale in market of Venice, Italy, August, 1905." (*Benton.*)

15672. Cucumis melo. **Muskmelon.**

"Muskmelon from market at Trieste, Austria, August, 1905. Probably brought up from Dalmatia. Sold under the name *Zate.* Medium to large-sized greenish yellow melon of fairly good quality; very warty, or covered with knobby excrescences." (*Benton.*)

15673 to 15682.

From the Office of Gardens and Grounds, turned over to the Office of Seed and Plant Introduction, September 8, 1905.

15673. Monstera deliciosa.

15674. Smilax medica.

15675. Sansevieria cylindrica.

15676. Clivia miniata.

15677. Maranta lineata rosea.

15678. Alocasia cuprea.

15679. Dieffenbachia seguine.

15680. Homeria discolor.

15681. Piper nigrum.

15682. Xanthosoma lindeni.

15683 to 15697.

From Sydney, New South Wales. Presented by Mr. J. H. Maiden, director and government botanist, Botanic Gardens. Received September 7, 1905.

15683. Acacia cunninghamii.

15684. Acacia cultriformis.

15685. Acacia neriifolia.

15686. Callitris calcarata.

15687. Callitris robusta.

15688. Casuarina stricta.

15689. Casuarina torulosa.

15690. Cordyline australis.

15691. Cordyline obtecta.

15692. Cordyline stricta.

15693. Ficus rubiginosa.

15694. Podocarpus elata.

15695. Sterculia acerifolia.

15696. Telopia speciosissima.

15697. Macadamia ternifolia.

15698 to 15744.

From Hillegom, Holland. Received thru R. Van der Schoot & Son, September 11, 1905.

15698 to 15709. Narcissus spp.

15710 to 15738. Tulipa spp.

15739 to 15743. Iris hispanica.

15744. Narcissus sp.

15745. PHYSALIS sp. **Ground cherry.**

From Lima, Peru. Received thru W. R. Grace & Co., September 11, 1905.

Capuli.

15746. LILIUM LONGIFLORUM EXIMEUM. **Easter lily.**

From Tarrytown, N. Y. Received thru F. R. Pierson & Co., September 11, 1905.

15747 to 15749. THEOBROMA CACAO. **Cacao.**

From Trinidad, British West Indies. Received thru Prof. J. H. Hart, Trinidad Botanical Gardens, September 11, 1905.

15747. *Calabacillo.*

15748. *Forastero.*

15749. *Criollo.*

15750. PISUM sp. **Pea.**

From Gyangtse, Tibet. Received from Captain O'Connor, of the British Indian army, thru Mr. M. A. Carleton, cerealist, September 8, 1905.

15751. BESCHORNERIA BRACTEATA.

From Nice, France. Received thru Mr. A. Robertson-Proschowsky, September 15, 1905.

15752.

From Richmond, Va. Received thru T. W. Wood & Sons, September 15, 1905.

Wood's Grain Pasture Mixture, said to be a mixture of wheat, barley, rye, winter turf oats, and hairy vetch.

15753 to 15758.

From Shanghai, China. Received thru Rev. J. M. W. Farnham, September 15, 1905.

Seeds obtained 150 miles southwest of Shanghai, except 15753.

15753. AMYGDALUS PERSICA. **Peach.**

15754. AMYGDALUS PERSICA. **Peach.**

15755. CUCUMIS MELO. **Muskmelon.**

15756. CUCUMIS MELO. **Muskmelon.**

15757. CUCUMIS MELO. **Muskmelon.**

15758. CITRULLUS VULGARIS. **Watermelon.**

15759 to 15761. ORYZA SATIVA. **Rice.**

From Kobe, Japan. Presented by Mr. Thomas F. McGrath, of the China and Japan Trading Company, of Kobe, Japan, thru Dr. W. H. McGrath, Delaware avenue and Market street, Camden, N. J., and Mr. T. F. Townsend, United States Weather Bureau, Philadelphia, Pa. Received August 1, 1905.

15759. Early glutinous rice. "Tastes better than ordinary rice." (*McGrath.*)

15760. Later glutinous rice.

15761. Early ordinary rice.

15762 and 15763.

From the greenhouses of the Department of Agriculture. Received September 18, 1905.

15762. HOMALOMENA WALLISI.

15763. DIEFFENBACHIA sp.

15764 to 15766.

From Hungary and Bulgaria. Secured by Mr. Frank Benton, of the Bureau of Entomology, and received September 19, 1905.

15764. CITRULLUS VULGARIS. **Watermelon.**

From Godollo. Small, round melon; dark green, with red flesh, thin rind, and brown seeds; small; quality excellent; quite sweet and juicy. Collected August 24, 1905. (No. 6.)

15765. CUCUMIS MELO. **Muskmelon.**

From Budapest. Small, yellowish green, closely netted, quite aromatic. Flesh green, quite juicy, tender, and of excellent quality. Seed from melon purchased on the market. (No. 7.)

15766. CITRULLUS VULGARIS. **Watermelon.**

From Sophia, Bulgaria. Yellow-cored, medium-sized, good quality. Flesh lemon yellow or light greenish yellow. (No. 9.)

15767 to 15772. NARCISSUS spp. **Narcissus.**

From Ettrick, Va. Received thru Poat Brothers, September 19, 1905.

15773 and 15774. NARCISSUS spp. **Narcissus.**

From Santa Cruz, Cal. Received thru Mr. E. Leedham, of the Leedham Bulb Company, September 21, 1905.

15775. ZEA MAYS. **Corn.**

From Adrianople, Turkey. Received thru Mr. Frank Benton, of the Bureau of Entomology, September 21, 1905.

"Small, orange-yellow flint corn, said to withstand drought well. Stalks grow about 4 feet tall. The region about Adrianople is a very dry one. (No. 10.)" (*Benton.*)

15776. CUCUMIS MELO. **Muskmelon.**

From Constantinople, Turkey. Received thru Mr. Frank Benton, September 21, 1905.

"Smooth skin, yellow outside; rather large, oval form; flesh greenish white, juicy and excellent flavor. (No. 11.)" (*Benton.*)

15777. OPUNTIA GYMNOCARPA. **Prickly pear.**

From Nice, France. Received thru Dr. A. Robertson-Proschowsky, September 22, 1905.

15778. ORYZA SATIVA. **Rice.**

From Macassar, Celebes. Received thru Mr. Karl Auer, United States consular agent, September 5, 1905.

15779. CAPRIOLA DACTYLON. **Bermuda grass.**

From New York, N. Y. Received thru J. M. Thorburn & Co., September 28, 1905.

15780. DIOSPYROS LOTUS. **Black jube.**

From Jamaica Plain, Mass. Received from the Arnold Arboretum, September 28, 1905.

15781. ADONIS AMURENSIS.

From London, England. Received thru William Cutbush & Son, Highgate Nurseries, September 28, 1905.

15782 to 15787. ARACHIS HYPOGAEA. **Peanut.**

From Marseille, France. Received thru Hon. Robert P. Skinner, United States consul-general, September 28, 1905.

15782. *First-class Java.* **15784.** *Java.*

15783. *Pondicherry.*

15785. *Gambia.*

"One of the best of the edible oil nuts from the West Coast of Africa." (*Skinner.*)

15786. *Ruffisque.*

"One of the best of the edible oil nuts from the West Coast of Africa." (*Skinner.*)

15787. *Chinese.*

"A low-grade nut for industrial oil only." (*Skinner.*)

15788. TRITICUM DURUM. **Macaroni wheat.**

From Fort Collins, Colo. Received thru Mr. O. B. Underwood, February, 1905.

15789 to 15796.

From Gotha, Orange County, Fla. Received thru Mr. H. Nehrling, Palm Cottage Experiment Gardens, September 30, 1905.

15789. ALOCASIA sp. (?).

15790. XANTHOSOMA MACULATUM. **Yautia.**

15791. COLOCASIA EUCHLORA (?). **Taro.**

15792. XANTHOSOMA sp. **Yautia.**

From Florida; said to have been cultivated by the Seminoles; common in old Florida gardens.

15793. XANTHOSOMA ROBUSTUM (?). **Yautia.**

15794. ALOCASIA VIOLACEA (?).

15795. COLOCASIA FONTANESII. **Taro.**

15796. COLOCASIA ILLUSTRIS. **Taro.**

15797 to 15802.

From Fairoaks, Cal. Received thru Mr. F. McMillan, October 2, 1905.

15797. AVENA SATIVA. **Oat.**

Belgian Winter. Grown from S. P. I. No. 9878.

15798. AVENA SATIVA. **Oat.**

Appler Rustproof. Grown from S. P. I. No. 11722.

15799. HORDEUM VULGARE. **Barley.**

Tennessee Winter. Grown from S. P. I. No. 11658.

15800. SECALE CEREALE. **Rye.**

Abruzzes. Grown from S. P. I. No. 10366.

15801. TRITICUM VULGARE. **Wheat.**

Fretes. Grown from S. P. I. No. 11714.

15802. TRITICUM VULGARE. **Wheat.**

Chul-bidai. Grown from S. P. I. No. 9131.

15803 to 15805.

From Mayaguez, P. R. Received thru the Agricultural Experiment Station, October 3, 1905.

15803. XANTHOSOMA sp. (?). **Yautia.**

"Probably identical with No. 15414." (*Barrett.*)

15803 to 15805—Continued.

15804. XANTHOSOMA SAGITTIFOLIUM. **Yautia.**

"From the Alta Vera Paz district of Guatemala. The yellow tubers seem to distinguish this from all other known sorts having reddish petioles." (*Barrett.*)

15805. DRACONTIUM ASPERUM. **"Guapa."**

"Resembles Amorphophallus, which was discovered on the upper Amazon and which appears to occur only in Porto Rico and Brazil. The large corm, when well matured, is cooked by the natives, and may be compared to squash in appearance, but has a strong flavor not usually relished at the first taste. The single leaf attains a height of 8 feet. The fetid effluvium of the flower is poisonous." (*Barrett.*)

15806. HYACINTHUS ORIENTALIS ALBULUS. **Hyacinth.**

From Boston, Mass. Received thru R. & J. Farquhar & Co., October 2, 1905.

15807 and 15808.

From Palm Springs, Cal. Received from Dr. Welwood Murray, thru Mr. T. H. Kearney, October 2, 1905.

15807. CHILOPSIS SALIGNA. **Desert willow.**

An ornamental shrub for desert regions.

15808. PARKINSONIA sp. **Palo verde.**

An ornamental desert shrub.

15809 to 15817.

From Hiroshima, Japan. Presented by Mr. J. T. Meyers. Received September 29, 1905.

15809. ERIOBOTRYA JAPONICA. **Loquat.**

15810. PRUNUS sp. **Japanese bush cherry.**

"These (15809 and 15810) are both nursery plants, the '*Usura*' (15810) probably thriving under such treatment as would be given young cherry trees." (*Meyers.*)

15811. BRASSICA sp. **Turnip.**

Shogo.

15812. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

15813. BRASSICA sp. **Turnip.**

Mammoth Red.

15814. RAPHANUS sp. **Radish.**

Sakura.

15815. RAPHANUS sp. **Radish.**

Moriguchi.

15816. CUCURBITA sp. **Squash.**

Tropical.

15817. CUCURBITA sp. **Squash.**

Kyoto.

15818 to 15820. FEIJOA sp. **"Guayabilla."**

From Buenos Aires, Argentina. Received thru Dr. Carlos Spegazzini, botanist of the Department of Agriculture, October 5, 1905.

15818. *Large.*

15819. *Smooth* or *Manzana.*

15820. *Small* or *Winter.*

15821 to 15824.

From Trebizond, Asiatic Turkey. Secured by Mr. Frank Benton, of the Bureau of Entomology. Received October 2, 1905.

Seeds obtained from Mr. Dem. Ch. Papathopoulos, of Samsoun, Asiatic Turkey.

15821. HORDEUM sp. **Barley.**

"Said to be of superior quality; not used as a forage crop, and the grain exported for use in the manufacture of beer, being especially suited for this." (No. 12.)

15822 to 15824. PAPAVER SOMNIFERUM. **Opium poppy.**

15822. *White-seeded.*

Grown near Samsoun, on the south coast of the Black Sea, Turkey in Asia. (No. 13.)

15823. Mixt.

Grown near Samsoun, Turkey in Asia. (No. 14.)

15824. *Blue-seeded.*

Grown near Samsoun, Turkey in Asia. (No. 15.)

15825. ANDROPOGON SORGHUM. **Milo.**

From Mecca, Cal. Received thru Brauckman Brothers, August 7, 1905.

15826. FESTUCA GIGANTEA.

From Agricultural College, Mich. Received thru Dr. W. J. Beal, September 20, 1905.

15827. CHAETOCHLOA ITALICA. **Millet.**

From St. Louis, Mo. Grown by Mr. W. J. Magee in 1904. Received September, 1905.

"The grain of the Ainu Japanese people. This sample was grown from Ainu seed." (*Magee.*)

15828. SCHOENOCAULON OFFICINALE (?). **"Cebadilla."**

From Vera Cruz, Mexico. Received thru Hon. William W. Canada, United States consul, October 5, 1905.

15829. HORDEUM VULGARE. **Barley.**

From Manhattan, Kans. Received thru Mr. A. M. Ten Eyck, October 6, 1905.

Tennessee Winter.

15830. HORDEUM VULGARE. **Barley.**

From Westminster, Md. Received thru Mr. H. L. Rhinehart, October 6, 1905.

Tennessee Winter.

15831. AMYGDALUS COMMUNIS. **Almond.**

From Grazalema, near Ronda, Spain. Received thru Mr. David Fairchild, October 9, 1905.

"This almond, a single tree of which stands in the 'huerta' of Señor Félix Enríquez, is, altho small, the highest-priced almond raised in the region, and conforms in shape and texture to the *Jordan* almond of Malaga. Its unusually thin shell and especially delicate kernel should make it of special value in California, where the tendency of these introduced hard-shelled almonds seems to be to become larger and coarser. This almond may develop in California into a larger sized superior type of *Jordan* almond." (*Fairchild.*)

15832. AMYGDALUS COMMUNIS. **Almond.**

From Ubrique, near Villa Martin, Spain. Received thru Mr. David Fairchild, October 9, 1905.

"A thin-skinned, fine type, of which few trees exist in Ubrique." (*Fairchild.*)

15833 to 15837. AMYGDALUS COMMUNIS. **Almond.**

From Grazalema, near Ronda, Spain. Received thru Mr. David Fairchild, October 9, 1905.

Almonds in the shell, purchased of Señor Félix Enríquez. "These five types, coming probably from seedling trees, are valuable for the production of seedlings, which may be better adapted to Californian conditions than the Jordan almond previously imported." (*Fairchild.*)

15833. *Larga.*

15834. *Almendron.*

15835. *Malagueña.*

15836. *Fino.*

"The Fino type is similar to No. 15831, and is the highest-priced almond in Grazalema." (*Fairchild.*)

15837. *Mollar Chico.*

"Soft-shelled, very small almond, of delicious texture." (*Fairchild.*)

15838. TACCA PINNATIFIDA. **Fiji arrowroot.**

From Oneco, Fla. Received thru Reasoner Brothers, Royal Palm Nurseries, October 9, 1905.

15839 to 15843. OPUNTIA spp. **Prickly pear.**

From Seville, Spain. Received thru Mr. Ambrosio Eschauzier, October 9, 1905.

15839. *Españoles.*

"A variety said to yield abundantly fruits of good flavor; not so well suited for fences as the more spiny varieties." (*Eschauzier.*)

15840. *Americanos.*

15841. *Moscatel*, or *Malagueños.*

15842. *Tintillas*, or *Viejas.*

15843. *Franceses.*

"Nos. 15842 and 15843 are used for hedges more than for fruit, on account of their large size and spininess." (*Eschauzier.*)

15844 to 15848. NARCISSUS spp. **Narcissus.**

From Santa Cruz, Cal. Received thru the Leedham Bulb Company, October 7, 1905.

15849. COCHLEARIA OFFICINALIS. **Scurvy grass.**

From London, England. Received thru Barr & Sons, October 9, 1905.

The famous scurvy grass, which is one of the cruciferous order to which the cresses belong, is found in England in three varieties. Its habit is to grow near the seashore; consequently, it is almost the first plant which a suffering crew would find ready to hand on landing. It is seen along the muddy banks of rivers and on seashores, especially near Lymington, in parts of Wales, and in Cumberland. One variety grows on the Scotch mountains. It is not a "grass" in any sense, but an upright plant with spoon-shaped leaves and large bunches of white and rather pretty flowers. The small species found on the Scotch hills is the Greenland scurvy grass.

15850. OPUNTIA FICUS INDICA. **Prickly pear.**

From Catania, Sicily. Received thru Charles Beck, esq., manager for the Duke of Bronte, Castel di Maniace, October 10, 1905.

Reputed at Catania to be the best sort grown in Sicily; fruit very sweet; seed small, probably abortive; color, pale yellow.

15851. CYTISUS SCOPARIUS. **Scotch broom.**

From New York, N. Y. Received thru J. M. Thorburn & Co., October 10, 1905.

15852. CENTROSEMA PLUMIERI.

From Mayaguez, P. R. Received thru Mr. H. C. Henricksen, horticulturist of the Agricultural Experiment Station, October 10, 1905.

From a vine grown from seed brought from St. Vincent, British West Indies, in 1903, by Mr. O. W. Barrett, botanist and entomologist of the Porto Rico Experiment Station. "This plant is giving excellent results as a cover crop in both Porto Rico and Hawaii, and is worthy of trial in the Southern States." (*Barrett.*)

15853 to 15874.

From McPherson, Kans. Received thru Mr. L. A. Fitz, October 6, 1905.

15853. TRITICUM MONOCOCCUM. **Einkorn.**

Fourth crop from German seed. (C. I. No. 1781.)

15854. TRITICUM MONOCOCCUM. **Einkorn.**

Fourth crop from seed found mixt with oats, S. P. I. No. 3676. (C. I. No. 2226.)

15855. TRITICUM MONOCOCCUM. **Einkorn.**

First crop from S. P. I. No. 10474. (C. I. No. 2433.)

15856 to 15864. AVENA SATIVA. **Oat.**

15856. *Burt.*

Second crop from seed from Virginia Agricultural Experiment Station, Blacksburg, Va. (C. I. No. 293.)

15857. *Sixty-Day.*

Third crop from S. P. I. No. 5938. (C. I. No. 165.)

15858. *Red Algerian.*

Second generation from S. P. I. No. 10269. (No. C. I. 337.)

15859. *Texas Red.*

From Agricultural Experiment Station seed, Manhattan, Kans.

15860. *Danish.*

First generation from New Zealand seed, S. P. I. No. 12877.

15861. *Dun.*

First generation from New Zealand seed, S. P. I. No. 12878.

15862. *Sparrowbill.*

First generation from New Zealand seed, S. P. I. No. 12879.

15863. *Canadian.*

First generation from New Zealand seed, S. P. I. No. 12880.

15864. *White Tartar.*

First generation from New Zealand seed, S. P. I. No. 12881.

15865. TRITICUM SPELTA. **Spelt.**

Fourth generation from seed from Agricultural Experiment Station, Pullman, Wash. (C. I. No. 1772.)

15866. HORDEUM VULGARE. **Barley.**

Tennessee Winter. First generation from S. P. I. No. 11780. (C. I. No. 2577.)

15867. HORDEUM DISTICHUM NUTANS. **Two-row barley.**

Hanna. Third generation from S. P. I. No. 9133. (C. I. No. 226.)

15853 to 15874—Continued.

15868. Secale cereale. **Rye.**

Fourth generation from Russian seed, obtained at the Paris Exposition. (C. I. No. 13.)

15869. Secale cereale. **Rye.**

Fourth generation from Russian seed obtained at the Paris Exposition. (C. I. No. 1.)

15870 to 15874. Triticum vulgare. **Wheat.**

15870. *Kharkof.*

Fourth generation from S. P. I. No. 7467. (C. I. No. 1583.)

15871. *Turkey.*

Fourth generation from seed from Harvey County, Kans. (C. I. No. 1558.)

15872. *Ulta.*

Fourth generation from S. P. I. No. 5638. (C. I. No. 1439.)

15873. *Crimean.*

Fourth generation from S. P. I. No. 5636. (C. I. No. 1437.)

15874. *Kharkof.*

Fourth generation from S. P. I. No. 5641. (C. I. No. 1442.)

15875. Bromus pacificus.

From Sitka, Alaska. Received thru Prof. C. C. Georgeson, Agricultural Experiment Station, October 13, 1905.

15876 to 15879. Musa spp. **Banana.**

From Manila, P. I. Received thru Mr. William S. Lyon, Bureau of Agriculture, October 16, 1905.

15876. *Carinosa.*

15877. *Lacatan.*

15878. *La Gloria.*

15879. *Bumulan.*

15880. Tamarindus indica. **Tamarind.**

From Manila, P. I. Received thru Mr. William S. Lyon, Bureau of Agriculture, October 16, 1905.

15881. Garcinia mangostana. **Mangosteen.**

From Port of Spain, Trinidad. Received thru Prof. J. H. Hart, Trinidad Botanical Department, October 21, 1905.

15882. Kunzea pomifera.

Received by the Office of Grass and Forage Plant Investigations without definite information as to the sender, October 17, 1905.

"Dense, prostrate, sand-binding plant. Grows only on sand hammocks, near the seacoast (in South Australia). Bears large quantities of edible berries in clusters of five or six. *Muntries* of natives; *native apples* of whites. Fruits have the odor and taste of apples."

15883. Oenothera ovata. **Evening primrose.**

From Santa Cruz, Cal. Received thru Mr. George J. Streator, October 17, 1905.

15884. Bromus inermis. **Smooth brome-grass.**

From Chicago, Ill. Received thru Mr. A. Dickinson, October 16, 1905.

15885. HEVEA sp. **Para rubber.**

From Amherst, Lower Burma. Received thru Mr. G. N. Collins, of the Bureau of Plant Industry, October 19, 1905.

"These plants were grown from seed sent by Mr. W. S. Todd, Amherst, Lower Burma. The trees from which the seed came were doubtless grown from seed distributed thruout India by the British Government many years ago." (*Collins.*)

15886. DURIO ZIBETHINUS. **Durian.**

From Singapore, Straits Settlements. Presented by Mr. G. O. Blacker. Received October 19, 1905.

15887. (Undetermined.) **Bean.**

From Chehkiang, China. Presented by Dr. S. P. Barchet, of the American consulate, Shanghai. Received October 21, 1905.

Stock feed bean. "This bean is found on the market in the west of Chehkiang Province, and is worth further investigation. It is sown broadcast in rice fields about the time they are being drained, two or three weeks before harvesting. Horses and cattle are fond of this plant, i. e., they eat it greedily, green or cured, with or without the bean." (*Barchet.*)

15888. PANICUM FRUMENTACEUM. **Millet.**

From Kin-hua-fu, Chehkiang, China. Presented by Dr. S. P. Barchet. Received October 21, 1905.

"A valuable variety of small glutinous grain millet grown in the western part of Chehkiang. Used as fodder and for brewing a beer tasting like wine." (*Barchet.*)

15889. ALOCASIA sp.

From Mayaguez, P. R. Received thru Mr. D. W. May, of the Agricultural Experiment Station, October 24, 1905.

"A fine ornamental, having the leaves (both sides) and petioles of a shining-purple shade. Height, 3 to 5 feet. Rhizome very poisonous by reason of its rhaphides." (*Barrett.*)

15890 to 15925.

From Ukiah, Cal. Received thru Mr. Carl Purdy, October 23, 1905.

15890 to 15895. LILIUM spp.

15896 to 15904. HYACINTHUS sp.

15905 to 15925. TULIPA spp.

15926. PHASEOLUS RADIATUS. **Mung bean.**

From Augusta, Ga. Received thru the N. L. Willet Drug Company, October 21, 1905.

15927. CYTISUS PROLIFERUS ALBUS. **Tagasaste.**

From the Canary Islands. Presented by Capt. Rosendo Torras, Brunswick, Ga., thru Hon. W. G. Brantley. Received October 20, 1905.

15928. PINUS PARVIFLORA. **Pine.**

From Washington, D. C. Received October 24, 1905.

Seed collected from a tree growing in the grounds of the United States Department of Agriculture.

15929. CITRULLUS VULGARIS. **Watermelon.**

From Dzansoul, Caucasus, Russia. Received thru Mr. Frank Benton, of the Bureau of Entomology, October 24, 1905.

"Grown at an altitude of 4,000 feet. Large, yellow-cored, slightly oval, with light-green skin and thin rind. (No. 16.)" (*Benton.*)

15930. Citrullus vulgaris. **Watermelon.**

From Dzansoul, Caucasus, Russia. Received thru Mr. Frank Benton, October 24, 1905.

"Alternate stripes of dark and light green, round, good quality. Small, yellow-cored. Grown at altitude of 4,000 feet. (No. 17.)" (*Benton.*)

15931. Physalis sp. **Ground cherry.**

From Bortschka, Caucasus, Russia. Received thru Mr. Frank Benton, October 24, 1905.

"Found growing wild on the south side of Tschoroch River some miles above Bortschka, southwestern Caucasus. Elevation about 2,000 feet. Fruit not edible but quite ornamental, being bright crimson in color, with large crimson seed pods, while leaves of plant are still green. (No. 18.)" (*Benton.*)

15932. Acer circinatum. **Maple.**

From Clearbrook, Wash. Received thru Mr. George Gibbs, October 21, 1905.

15933 to 15940.

From Shanghai, China. Received thru Rev. J. M. W. Farnham, of the China Tract Society, October 26, 1905.

15933. Lilium sp.
15934. (Undetermined.)
15935. Amygdalus persica.
15936. (Undetermined.)
15937. Cucurbita sp.
15938. (Undetermined.)
15939. (Undetermined.)
15940. (Undetermined.)

15941. Colocasia antiquorum esculentum. **Taro.**

From Gotha, Fla. Presented by Mr. H. Nehrling. Received October 26, 1905.

Wild taro, erroneously called "Tanyah."

15942 and 15943. Lilium longiflorum hyb. **Lily.**

From Bellingham, Wash. Received thru Mr. John W. Macrae Smith, October 11, 1905.

15942. Lilium longiflorum eximium giganteum.

Grown in one year from S. P. I. No. 11591.

15943. Lilium longiflorum multiflorum.

Grown in one year from S. P. I. No. 11794.

15944. Lilium candidum. **Lily.**

From Olympia, Wash. Received thru Mr. B. F. Denton, September 14, 1905.

15945 and 15946. Cynara scolymus. **Artichoke.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., October 27, 1905.

15945. *Large Flat Brittany.*
15946. *Large Globe*, or *Paris.*

15947 to 15954.

From Hamel, West Australia. Received thru Mr. George F. Berthoud, director of the State farm, October 26, 1905.

15947. Atriplex holocarpa.
15948. Atriplex leptocarpa.
15949. Andropogon sericeus.
15950. Astrebla triticoides.
15951. Microlaena stipoides.
15952. Danthonia semiannularis.
15953. Clianthus dampierii.
15954. Swainsona macculochia.

15955. ELYMUS CANADENSIS. **Wild rye.**

From Manistee, Mich. Received thru Mr. Stephen Cahill, October 26, 1905.

15956 to 16128. BROMUS spp. **Brome-grass.**

From Cambridge, England. Presented by Prof. Marshall Ward, of the Botanic Gardens. Received October 28, 1905.

Sample packets of the following varieties of Bromus gathered from various parts of the world:

15956. BROMUS sp., Switzerland, 1902. (186)
15957. BROMUS sp., St. Petersburg, 1903. (229)
15958. BROMUS sp., St. Owens Bay, Jersey. (240)
15959. BROMUS sp., St. Owens Bay, Jersey, 1903. (241)
15960. BROMUS ADOENSIS, Kew, 1902. (9)
15961. BROMUS ALOPECURUS, Lisbon, 1903. (216)
15962. BROMUS ALTISSIMUS, H. & S., 1903. (230)
15963. BROMUS ANDINUS, Stockholm, 1904. (252)
15964. BROMUS ANGUSTIFOLIUS, Berlin, 1902. (10)
15965. BROMUS ANGUSTIFOLIUS, Heidelberg, 1903. (215)
15966. BROMUS ARDUENNENSIS, H. & S., 1902. (11)
15967. BROMUS ARDUENNENSIS, Paris, 1902. (12)
15968. BROMUS ARDUENNENSIS, Schroeter, 1903. (13)
15969. BROMUS ARDUENNENSIS, Brussels, 1902. (184)
15970. BROMUS ARDUENNENSIS VILLOSUS, Brussels, 1902. (185)
15971. BROMUS ARENARIUS, Sydney, 1902. (210)
15972. BROMUS ARVENSIS, Sutton, 1901. (128)
15973. BROMUS ASPER, Coe Fen., Cambridge, 1901, A. H. (1)
15974. BROMUS BIEBERSTEINII, Schroeter, 1902. (14)
15975. BROMUS BRACHYSTACHYS, Upsala, 1902. (16)
15976. BROMUS BREVIARISTATUS, Rocky Mountains, 1902. (15)
15977. BROMUS BREVIARISTATUS, Kew, 1902. (150)
15978. BROMUS BRIZAEFORMIS, Sutton, 1901. (129)
15979. BROMUS CANADENSIS, Hamburg, 1902. (28)
15980. BROMUS CANADENSIS, Glasnevin, 1902. (29)
15981. BROMUS CANADENSIS, St. Petersburg, 1902. (30)
15982. BROMUS CANADENSIS, Sutton, 1901. (130)
15983. BROMUS CANADENSIS, Naples, 1904. (247)
15984. BROMUS CARINATUS, Kew, 1902. (151)
15985. BROMUS CILIATUS, Cracow, 1902. (19)
15986. BROMUS CILIATUS, Schroeter, 1902. (21)
15987. BROMUS CILIATUS, Kew, 1902. (22)
15988. BROMUS CILIATUS, H. & S., 1902. (23)
15989. BROMUS CILIATUS, Paris, 1902. (25)
15990. BROMUS CILIATUS, Vienna, 1902. (26)
15991. BROMUS CILIATUS, B. G. C., 1901. (170)
15992. BROMUS CILIATUS, B. G. C., 1901. (171)
15993. BROMUS CILIATUS, J. Fletcher, 1902. (187)

15956 to 16128—Continued.

15994. Bromus ciliatus (glabrous var.), Bonn, 1902. (20)
15995. Bromus commutatus, Schroeter, 1902. (33)
15996. Bromus commutatus, Madingley, 1903, A. H. (239)
15997. Bromus condensatus, Hack., Schroeter, 1902. (34)
15998. Bromus confertus, Glasnevin, 1902. (35)
15999. Bromus congestus, Glasnevin, 1902. (36)
16000. Bromus crinitus, St. Petersburg, 1901. (152)
16001. Bromus danthoniae, St. Petersburg, 1902. (38)
16002. Bromus diandrus, Glasnevin, 1902. (37)
16003. Bromus erectus, Schroeter, 1902. (40)
16004. Bromus erectus laxus, Strassburg, 1903. (218)
16005. Bromus erectus transylvanicus, Hack., Stockholm, 1902. (118)
16006. Bromus erectus villosus (?), Cherryhinton, 1903, A. H. (214)
16007. Bromus fibrosus, Hack., Schroeter, 1902. (41)
16008. Bromus fimbriatus violaceus, H. & S., 1902. (42)
16009. Bromus fimbriatus violaceus, H. & S., 1903. (219)
16010. Bromus giganteus, Cherryhinton, 1901, A. H. (45)
16011. Bromus giganteus triflorus, S. H. Beckham, 1903. (211)
16012. Bromus grossus, H. & S., 1902. (43)
16013. Bromus gussoni, Glasnevin, 1902. (44)
16014. Bromus gussoni, Benary, 1902. (46)
16015. Bromus hookerianus, Vienna, 1902. (48)
16016. Bromus hordeaceus, St. Petersburg, 1902. (50)
16017. Bromus hordeaceus glabrescens, St. Petersburg, 1902. (49)
16018. Bromus inermis, Schroeter, 1902. (32)
16019. Bromus inermis, Sutton, 1901. (137)
16020. Bromus inermis, B. G. C., 1901. (176)
16021. Bromus inermis (awned var.), St. Petersburg, 1902. (51)
16022. Bromus inermis (viviparous form), Shroeter, 1902. (52)
16023. Bromus intermedius, B. G. C., 1901. (53)
16024. Bromus interruptus, Sutton, 1901. (136)
16025. Bromus japonicus, St. Petersburg, 1902. (54)
16026. Bromus japonicus, Tokyo, 1903. (236)
16027. Bromus kalmii, Paris, 1902. (55)
16028. Bromus kalmii, Kew, 1901. (58)
16029. Bromus krausei, St. Petersburg, 1902. (59)
16030. Bromus krausei, Oxford, 1903. (234)
16031. Bromus laevipes, St. Petersburg, 1902. (67)
16032. Bromus laevipes, Hamburg, 1902. (220)
16033. Bromus laxus, Glasnevin, 1902. (65)
16034. Bromus laxus, Sutton, 1902. (168)
16035. Bromus laxus, Vienna, 1902. (191)
16036. Bromus longiflorus, Paris, 1902. (61)
16037. Bromus longiflorus, Glasnevin, 1902. (62)

15956 to 16128—Continued.

16038. Bromus longiflorus, Upsala, 1902. (63)
16039. Bromus macranthus, Naples, 67, 1904. (253)
16040. Bromus macrostachys, Sutton, 1901. (140)
16041. Bromus macrostachys, Coimbra, 1901. (173)
16042. Bromus macrostachys lanuginosus, Palermo, 1902. (190)
16043. Bromus madritensis, Mrs. Gregory, 1904.
16044. Bromus madritensis, Old Walls, Carrick on Luir, Tipperary, 1902. (242)
16045. Bromus madritensis, Sutton, 1901. (139)
16046. Bromus madritensis delilei, B. G. C., 1901. (100)
16047. Bromus marginatus, St. Petersburg, 1902. (75)
16048. Bromus marginatus, U. S. Dept. Agr., 1902. (202)
16049. Bromus maximus gussoni, Palermo, 1903. (233)
16050. Bromus mollis, Sutton, 1901. (138)
16051. Bromus mollis (deformed fls.), Grumpington Road, August 27, 1902, A. H. (235)
16052. Bromus mollis glabratus, Hayle, Cornwall, 1902. (212)
16053. Bromus mollis lloydianus, Lizard, 1902. (206)
16054. Bromus mollis thominii, B. G. C., 1902. (169)
16055. Bromus multiflorus, Schroeter, 1902. (72)
16056. Bromus parviflorus, Schroeter, 1902. (79)
16057. Bromus patulus, Benary, 1902, (87)
16058. Bromus patulus, Hills Avenue, 1902, A. H. (204)
16059. Bromus patulus nanus, Benary, 1902. (90)
16060. Bromus pendulus, Lyons, 1902. (96)
16061. Bromus pitensis, St. Petersburg, 1902. (95)
16062. Bromus pitensis, Quito, 1903. (232)
16063. Bromus porteri frondans (?), U. S. Dept. Agr., 1902. (198)
16064. Bromus pubescens, Berlin, 1902. (86)
16065. Bromus pumpellianus, Saunders, 1902. (97)
16066. Bromus pumpellianus, Wawanesa, 1902. (192)
16067. Bromus pungens (33.01), B. G. C., 1901. (162)
16068. Bromus pungens ciliatus (?), B. G. C. (37), 1901. (160)
16069. Bromus purgans, Glasnevin, 1902. (81)
16070. Bromus purgans, Hamburg, 1902. (82)
16071. Bromus purgans, Kew, 1902. (83)
16072. Bromus purgans, Lemberg, 1902. (85)
16073. Bromus purgans (41), B. G. C., 1901. (164)
16074. Bromus purgans, B. G. C., 1901. (175)
16075. Bromus purpurascens, Hamburg, 1902. (93)
16076. Bromus purpurascens, Glasnevin, 1902. (94)
16077. Bromus racemosus, near Madingley Chalk Pit, A. H., 1902. (213)
16078. Bromus racemosus, Hamburg. (221)
16079. Bromus racemosus, Kew, 1903. (222)
16080. Bromus racemosus, Breslau, 1903. (223)

15956 to 16128—Continued.

16081. Bromus racemosus, Lyon, 1903. (224)
16082. Bromus racemosus, Babraham, 1903, R. I. Lynch. (237)
16083. Bromus racemosus, Madingley, 1903, A. H. (238)
16084. Bromus racemosus, Madingley, June 28, 1903, A. H. (243)
16085. Bromus richardsoni, U. S. Dept. Agr., 1902. (200)
16086. Bromus rigidus, Kew, 1901. (69)
16087. Bromus rubens, Montpelier, 1902. (101)
16088. Bromus rubens, U. S. Dept. Agr., 1902. (203)
16089. Bromus schraderi, Correvon, 1902. (113)
16090. Bromus schraderi, Upsala, 1902. (114)
16091. Bromus secalinus, Sutton, 1901. (146)
16092. Bromus secalinus, U. S. Dept. Agr., 1902. (194)
16093. Bromus secalinus multiflorus, Upsala, 1902. (116)
16094. Bromus segetum, U. S. Dept. Agr., 1902. (115)
16095. Bromus squarrosus, St. Petersburg, 1902. (78)
16096. Bromus squarrosus, Glasnevin, 1902. (102)
16097. Bromus squarrosus, near *B. rubens*, Roven, 1902. (103)
16098. Bromus squarrosus, Chelsea, 1902. (104)
16099. Bromus squarrosus, Correvon, 1902. (105)
16100. Bromus squarrosus, Schroeter, 1902. (106)
16101. Bromus squarrosus, Paris, 1902. (107)
16102. Bromus squarrosus villosus, Schroeter, 1902. (112)
16103. Bromus squarrosus wolgensis, St. Petersburg. 1902. (110)
16104. Bromus stenophyllus, Glasnevin, 1903. (225)
16105. Bromus sterilis, Sutton, 1901. (145)
16106. Bromus tacna, Paris, 1902. (120)
16107. Bromus tacna, Kew, 1901. (158)
16108. Bromus tacna, Warsaw. (246)
16109. Bromus tectorum, Sutton, 1901. (147)
16110. Bromus tectorum, U. S. Dept. Agr., 1902. (197)
16111. Bromus trinii, Kew, 1905.
16112. Bromus unioloides, Stockholm, 1902. (121)
16113. Bromus unioloides, Schroeter, 1902. (122)
16114. Bromus unioloides, Heidelberg, 1902. (123)
16115. Bromus unioloides, Sutton, 1901. (144)
16116. Bromus unioloides, Sutton, 1901. (148)
16117. Bromus unioloides, B. G. C., 1901. (156)
16118. Bromus unioloides, B. G. C., 1901. (161)
16119. Bromus unioloides, Palermo, 1902. (193)
16120. Bromus unioloides, Upsala, 1902. (207)
16121. Bromus unioloides, Penzance, 1902, A. H. (208)
16122. Bromus unioloides, Quito, 1903. (231)
16123. Bromus unioloides willdenowii, U. S. Dept. Agr., 1902. (196)
16124. Bromus valdivianus, H. & S., 1902. (126)

15956 to 16128—Continued.

16125. Bromus variegatus, Vienna, 1902. (125)

16126. Bromos vestitus, Griesswald, 1903. (228)

16127. Bromus virens, Benary, 1902. (124)

16128. Bromus willdenowii Kth., U. S. Dept. Agr., 1902. (195)

16129. Phaseolus max. **Mung bean.**

From New Orleans, La. Received thru Mr. R. E. Blouin, assistant director, Louisiana Sugar Experiment Station, Audubon Park, November 8, 1905.

16130. Pisum arvense. **Canada field pea.**

From Chicago, Ill. Received thru A. Dickinson & Co., November 8, 1905.

16131. Garcinia mangostana. **Mangosteen.**

From Heneratgoda, Ceylon. Received thru J. P. William & Bros., November 10, 1905.

"For experiments in grafting on a more resistant stock." (*Fairchild.*)

16132. (Undetermined.) **Aroid.**

From greenhouses of Public Buildings and Grounds, Washington, D. C. Received in June, 1904. Numbered November 10, 1905.

16133. Persea indica.

From Funchal, Madeira. Presented by Mr. J. B. Blandy. Received November 9, 1905.

"A species related to the avocado of commerce; for breeding purposes and as a stock." (*Fairchild.*)

16134. (Undetermined.) **"Catispa."**

From Guadalajara, Mexico. Received thru Mr. A. W. Geist, November 10, 1905.

"A quick-growing hardwood tree used for live posts for wire fences." (*Geist.*)

16135. Melilotus alba. **Sweet clover.**

From Augusta, Ga. Received thru the N. L. Willet Drug Company, November 8, 1905.

16136. Medicago sativa. **Alfalfa.**

From Billings, Mont. Received thru Mr. I. D. O'Donnell, October 31, 1905.

16137. Lathyrus silurus.

From Salonica, Turkey. Received thru Mr. J. Henry House, October 30, 1905.

"Extensively used as food for cattle. When burned like coffee it is said to make very good cereal coffee—better than barley." (*House.*)

16138. Medicago lupulina. **Black medick, or yellow trefoil.**

From New York, N. Y. Received thru J. M. Thorburn & Co., October 30, 1905.

16139. Xanthosoma sp. **Yautia.**

From Tepatitlan, Jalisco, Mexico. Received thru Mr. W. E. Safford, from Mr. C. V. Mead, October 31, 1905.

"This yautia apparently belongs to a type distinct from the West Indian forms; the petioles are purplish but the rhizome, tho of two seasons' growth, shows no indications of having produced tubers. This plant is prized by the natives, who sometimes call it "Papa de Colomo." The water in which the rhizomes are boiled should be changed several times." (*Barrett.*)

16140. Swainsona maccullochiana.

From Sydney, New South Wales. Presented by Mr. J. H. Maiden, director of the Botanic Gardens. Received October 30, 1905.

"This is one of the most horticulturally valuable of all Swainsonas." (*Maiden.*)

16141 to 16159.

Presented by Dr. J. N. Rose, of the United States National Museum, having been collected by him during the summer of 1905, while in Mexico. Received October 30, 1905. The numbers in parentheses are those of Doctor Rose.

16141. Amaryllidaceae.

From 'Pedregal," near Tlalpam, Valley of Mexico. (1013/05.)

16142. Hymenocallis sp.

From limestone hillsides, Tula, Hidalgo. (1036/05.)

16143. Anthericum sp.

From limestone hillsides, Tula, Hidalgo. (1037/05.)

16144. (Undetermined.)

From limestone hillsides, Tula, Hidalgo. (1038/05.)

16145. (Undetermined.)

From limestone hillsides, Tula, Hidalgo. (1039/05.)

16146. (Undetermined.)

From limestone hillsides, Tula, Hidalgo. (1040/05.)

16147. Hymenocallis sp.

From limestone hillsides, Yautepec, Morelos. (1066/05.)

16148. Amaryllidaceae.

In barranca of Rio Aqueduct to near Santa Fe. D. F. (1087/05.)

16149. Sprekelia sp.

From mountains near Pachuca. (1108/05.)

16150. Zephyranthes sp.

From mountains near Pachuca. (1109/05.)

16151. Milla biflora.

From limestone hills near Ixmiquilpam. (1161/05.)

16152. (Undetermined.)

From limestone hillside near Ixmiquilpam. (1162/05.)

16153. (Undetermined.)

From stony hillsides near San Juan del Rio, Quer. (1214/05.)

16154. Echeandia sp.

From stony hillside near San Juan del Rio, Quer. (1216/05.)

16155. (Undetermined.)

From between Cadereyta and Visaron. (1264/05.)

16156. (Undetermined.)

From between Cadereyta and Visaron. (1270/05.)

16157. (Undetermined.)

From hills near El Riego. (1312/05.)

16158. Talinum sp.

From hills near El Riego. (1317/05.)

16159. Agave sp.

From near Cuernavaca, Morelos. (1350/05.)

16160. POLYPTERIS TEXANA.

From Kosse, Tex. Collected by Mr. A. J. Pieters in October, 1905.

Very brilliant rose-colored flowers.

16161. ARACHIS HYPOGAEA. **Peanut.**

From Paris, France. Received thru Vilmorin-Andrieux & Co., October 28, 1905.

16162 to 16164. ARACHIS HYPOGAEA. **Peanut.**

From St. Louis, Mo. Secured by Mr. M. A. Carleton at the Louisiana Purchase Exposition, 1904.

16162. *Nápoli.* From Italy.

16163. *Salerno.* From Italy.

16164. (Unnamed sample from Argentina.)

16165. ZIZANIA AQUATICA. **Wild rice.**

From Port Hope, Canada. Received thru Mr. Charles Gilchrist, November 2, 1905.

16166 to 16168. VIGNA SINENSIS. **Cowpea.**

From St. Louis, Mo. Obtained by Mr. M. A. Carleton in the summer of 1904, at the Louisiana Purchase Exposition.

16166. *Black-eyed.* Labeled *Cosenza.*

Probably from Italy.

16167. *Black-eyed.*

From Reggio Calabria. From the Italian exhibit.

16168. Same as 16167, but labeled *Caserta.*

16169 and 16170. PERSEA spp.

From Monte, Grand Canary. Received thru Mr. Alaricus Delmard, Hotel Santa Brigida, November 2, 1905.

16169. PERSEA INDICA.

16170. PERSEA GRATISSIMA. **Avocado.**

16171 to 16174. BROMUS INERMIS. **Smooth brome-grass.**

From Dwight, Nebr. Received thru Mr. J. P. Dunlap, November 1, 1905.

16171. *Yellow.*

"Best of all the varieties." (*Dunlap.*)

16172. *Hansen's.*

"Much like the yellow, but heads show less pink color when ripening and blades show more purple when dying. Field generally shows less yellow color; nearly as tall as yellow, but less stout in sod. Originally from South Dakota Experiment Station." (*Dunlap.*)

16173. *Colorado.*

"Dark purplish heads; nearly as dark as the darkest kinds, but fading as the heads ripen. Blades nearly as light as those of the *Yellow.* Not so large a grower as the *Yellow* or *Hansen.* Has been experimented with at the Colorado Experiment Station. From Keen Brothers, Pueblo, Colo." (*Dunlap.*)

16174. *Large Dark.*

"Very dark-colored heads when ripening, turning to a reddish brown. Barely equals other kinds in amount of feed; quality not quite so good. On hard land does not stand as well as the others. From R. Rabler, Leigh, Nebr." (*Dunlap.*)

16175 to 16188. Ipomoea batatas. **Sweet potato.**

From the Arlington Farm of the United States Department of Agriculture. Received November 1, 1905.

Fourteen of the best varieties, selected by Mr. W. R. Beattie.

16175. *Florida.*
16176. *McCoy.*
16177. *Hamburg.*
16178. *White Yam.*
16179. *Miles Yam.*
16180. *Early General Grant.*
16181. *Big Stem Jersey.*
16182. *Red Nansemond.*
16183. *Red Jersey.*
16184. *Bermuda Red.*
16185. *Van Nest Red.*
16186. *Early Red Carolina.*
16187. *Bronze Spanish.*
16188. *Southern Queen.*

16189. Oryza glutinosa. **Glutinous rice.**

From Kiangsu Province, China. Presented by Dr. S. P. Barchet, of Shanghai, China. Received November 4, 1905.

"Doctor Barchet states that the glutinous rice of China brings a higher price and has a better flavor than ordinary rice. He personally prefers it to the latter and advises a mixture of the glutinous with the ordinary rice, claiming that it adds distinctly to the flavor of the dish. This is not the red rice which is considered by our planters as a weed, but is a distinct variety." (*Fairchild.*)

16190. Zea mays. **Corn.**

From Leman, Caucasus, Russia. Received thru Mr. Frank Benton, of the Bureau of Entomology, November 2, 1905.

16191 to 16193.

From the Bulgarian exhibit at the Louisiana Purchase Exposition, 1904. Received November 7, 1905.

16191. Vicia villosa. **Hairy vetch.**
16192. Vicia sp. **Vetch.**
16193. Brassica napus. **Rape.**

16194. Curcuma amada. **Mango ginger.**

From Madras, India. Received thru G. Rajah Gopal Naidu, agricultural inspector, June 26, 1903. Numbered November 10, 1905.

16195. Zingiber sp.

(Origin in doubt.) Received in November, 1905.

16196. Curcuma longa. **Turmeric.**

From Mayaguez, P. R. Presented by Mr. H. C. Henricksen, horticulturist of the Agricultural Experiment Station. Received November 7, 1905.

"This plant was introduced from the Orient many years ago and has escaped from cultivation and become a troublesome weed in pastures in the western portion of Porto Rico. It flowers freely, but spreads only from the roots. It is one of the two or three commercial turmerics, but has no sale in this country because the special process by which it is prepared in the Orient is unknown here." (*Barrett.*)

16197 to 16207.

From Dr. J. N. Rose, of the United States National Museum, Washington, D. C. Received November 7, 1905.

16197. Yucca sp.

Lower California, 1905. (E. W. Nelson No. 7129.)

16197 to 16207—Continued.

16198. Agave sp.

Lower California, 1905. (E. W. Nelson No. 7151.)

16199. (Undetermined.)

Lower California, 1905. (E. W. Nelson No. 7157.)

16200. Ibervillea sonorae.

Lower California, 1905. (E. W. Nelson No. 7182.)

A large cucurbit vine; lives in dry regions and forms a large, bulbous root.

16201. Ibervillea sp.

Lower California, 1905. (E. W. Nelson No. 7182.)

16202. (Undetermined.)

Laredo, Tex., June 27, 1905. (J. N. Rose No. 1013.)

16203. (Undetermined.)

"Bulb" from Haciendo Ciervo, Mexico, 1905. (J. N. Rose No. 1266/05.)

16204. Zephyranthes sp.

From mountains near Pachuca, Mexico, 1905. (J. N. Rose 1109/05.)

16205. Dasylirion sp. nov.

Limestone hills west of El Riego, Tehuacan, Puebla, Mexico, 1905. (J. N. Rose No. 10009.)

16206. Agave sp.

El Riego, Tehuacan, Puebla, Mexico, 1905. (J. N. Rose No. 10006.)

16207. Amphypterygium sp.

Near Tomellin, Oaxaca, Mexico, 1905. (J. N. Rose No. 10096.)

16208. DAVIDIA INVOLUCRATA. **Davidia.**

From London, England. Received thru J. Veitch & Sons, November 2, 1905.

In the whole vegetable kingdom there is not a more striking object than a tree of Davidia when covered with its pure white bracts, which make it conspicuous at a great distance. It is a handsome tree, growing to a height of 60 to 70 feet, with foliage much resembling that of our common linden or basswood. When in full flower it is said to be a marvelous sight, owing to the alternate white and green caused by the large bracts intermingling with the leaves. The flowers themselves are polygamo-diœcious, all borne in heads inside a pair of large, white bracts about 3 inches long, with conspicuous red-anthered stamens and a long, bottle-shaped gynœcium. Botanically, the plant is allied to the dogwoods.

Growing at an elevation of 6,000 to 7,000 feet in central China, where the minimum temperature is about 5° F., there ought to be little doubt as to its hardiness in the greater part of the United States. Trees set out in France have survived the winters at Paris, while others in England have withstood 15 degrees of frost unprotected. Until well established, however, some protection in very severe weather is recommended. New plants are readily obtained by cuttings or by layering, and should be planted in a rich soil, with some protection from too much sunshine.

16209. MEDICAGO SATIVA. **Alfalfa.**

From Chicago, Ill. Received thru the A. Dickinson Company, November 8, 1905.

16210 and 16211. PHASEOLUS RADIATUS. **Mung bean.**

From Chillicothe, Tex. Received thru Mr. A. B. Conner, November 7, 1905.

16210. Grown from S. P. I. No. 13394.

16211. Grown from S. P. I. No. 8540.

16212. (Undetermined.)

From Newcastle, New South Wales. Received thru Dr. Frederic W. Goding, United States consul, November 8, 1905.

16213. Medicago maculata. **Bur clover.**

From Abbeville, S. C. Received thru Mr. Arthur Parker, November 11, 1905.

16214. Musa textilis. **Manila hemp.**

From Manila, P. I. Received thru Mr. W. S. Lyon, Insular Bureau of Agriculture, November 13, 1905.

16215 to 16222. Erodium spp.

From Geneva, Switzerland. Received thru Mr. H. Correvon, November 13, 1905.

16215. Erodium hymenodes.

16216. Erodium chelidonifolium.

16217. Erodium pelargonifolium.

16218. Erodium daucoides.

16219. Erodium glandulosum.

16220. Erodium macradenum.

16221. Erodium manescavi.

16222. Erodium macrophyllum.

16223. Carum gairdneri.

From Pendleton, Oreg. Received thru Mr. W. H. Bleakney, November, 1905.

"This plant was formerly a staple article of food among the Umatilla and other Indian tribes of the Pacific Northwest. The roots may be eaten either raw or cooked. They have a delicious flavor." (*Coville.*) (See also No. 12932.)

16224. Blighia sapida. **Akee.**

From Kingston, Jamaica. Received thru Mr. G. N. Collins, November, 1905.

"Unless fully matured, the white fleshy arillus of this excellent fruit is regarded as poisonous by the natives of Jamaica." (*Collins.*)

16225 and 16226. Xanthosoma spp. **Yautia.**

From Floral Park, Long Island, N. Y. Received thru Mr. John Lewis Childs, November 17, 1905.

16225. Xanthosoma sagittifolium.

16226. Xanthosoma sp.

16227. Eucalyptus goniocalyx. **Eucalypt.**

From Guadalajara, Mexico. Received thru Mr. Federico Chisolm, November 17, 1905.

16228. Poa pratensis. **Kentucky bluegrass.**

From Winchester, Ky. Received thru Mr. D. S. Gay, November 17, 1905.

16229. Vigna sinensis. **Cowpea.**

From Bristol, Conn. Received thru Mr. Herman Ockels, November 10, 1905.

16230. Paspalum dilatatum. **Large water grass.**

From Biloxi, Miss. Received thru Mr. S. M. Tracy, November 18, 1905.

16231. Aralia racemosa. **Spikenard.**

From North Clarendon, Vt. Received thru Mr. James Barrett, November 21, 1905.

Roots and berries of the wild spikenard are used in the preparation of a remedy for catarrhal affections. For use in breeding with *Aralia cordata*, the Japanese "udo."

16232. TECOMA CAPENSIS (?).

From Lourenço Marquez, Portuguese East Africa. Received thru Hon. W. Stanley Hollis, United States consul, November 21, 1905.

"Seeds of a native African shrub that is much used in making hedges. Might be advantageously used in the warmer parts of the United States." (*Hollis.*)

16233 to 16236. ARACHIS HYPOGAEA. **Peanut.**

From Sydney, New South Wales. Received thru Mr. Walter S. Campbell, director of agriculture, Department of Mines and Agriculture, November 22, 1905.

16233. *Mammoth Bush.*

16234. *Improved Large.*

16235. *Cluster.*

16236. *Small.*

16237 to 16243. NEPHELIUM LITCHI. **Litchi.**

From Canton, China. Secured thru Dr. John M. Swan, of the Medical Missionary Hospital, and forwarded by the Yokohama Nursery Company, Yokohama, Japan. Received at Berkeley, Cal., October, 1905.

"This fruit tree, represented by many varieties, is worthy of thoro trial in Porto Rico, Hawaii, southern California, and Florida. It is one of the most delicious fruits in the world." (*Fairchild.*)

16237. (Without labels.)

16238. (No. 1.)

16239. *Hak Ip.*

A favorite early sort, ripening in the fifth month.

16240. *Nue Mai.*

A large-fruited, small-seeded variety extremely sweet. Ripens in the fifth or sixth month.

16241. *Kwai Mai.*

A very popular sort. Ripens at end of fifth month.

16242. (No. 2.)

16243. (No. 3.)

16244. FESTUCA OVINA INGRATA.

From Wenache Mountains, Washington, at an altitude of 6,000 feet. Collected by Mr. J. S. Cotton, of the Department of Agriculture, September, 1904. Received November, 1905.

16245 to 16247.

From New York, N. Y. Received thru Henry Nungesser & Co., November 21, 1905.

16245. ARRHENATHERUM ELATIUS. **Tall meadow oat-grass.**

16246. ONOBRYCHIS ONOBRYCHIS. **Sainfoin.**

16247. HOLCUS LANATUS. **Velvet grass.**

16248 to 16253. SOLANUM TUBEROSUM. **Potato.**

From Portsmouth, Va. Grown under the direction of Mr. W. A. Orton, of the Department of Agriculture, during the summer of 1905, from seed potatoes introduced from Ecuador, July, 1905.

16248. Round white potatoes.

Grown from S. P. I. No. 14973; first type. (P. B. No. 679b.)

16249. Round or elongated red potatoes.

Grown from S. P. I. No. 14973; second type. (P. B. No. 679c.)

16250. Elongated white potatoes.

Grown from S. P. I. No. 14973; third type. (P. B. 679d.)

16251. Round dark-red potatoes.

Grown from S. P. I. No. 14893. (P. B. No. 676.)

16252. Round white potatoes.

Grown from S. P. I. No. 14894. (P. B. No. 677.)

16253. Oval white potatoes.

Grown from S. P. I. No. 14895. (P. B. No. 678.)

16254 to 16275.

From Karlsruhe, Germany. Received thru the Botanic Gardens, November 17, 1905.

16254. Aegilops squarrosa.
16255. Arrhenatherum elatius.
16256. Brachypodium pinnatum.
16257. Eleusine tocussa.
16258. Erodium gruinum.
16259. Erodium stephanianum.
16260. Medicago ciliaris.
16261. Medicago echinus.
16262. Medicago elegans.
16263. Medicago sativa × falcata.
16264. Medicago minima.
16265. Medicago orbicularis.
16266. Medicago radiata.
16267. Medicago scutellata.
16268. Melilotus altissima.
16269. Melilotus italica.
16270. Trigonella coerulea.
16271. Trigonella corniculata.
16272. Triticum rigidum.
16273. Triticum trichophorum.
16274. Vicia cornigera.
16275. Vicia dumetorum.

16276 to 16302.

From Strassburg, Germany. Received thru the Botanic Gardens, November 21, 1905.

16276. Aegilops speltoides.
16277. Avena brevis.
16278. Avena hirsuta.
16279. Avena ludoviciana.
16280. Avena orientalis.
16281. Avena planiculmis.
16282. Avena strigosa.
16283. Bromus erectus.
16284. Erodium gruinum.
16285. Lappago racemosa.
16286. Medicago gerardi.
16287. Medicago terebellum.
16288. Medicago turbinata.
16289. Melilotus alba.
16290. Phaseolus caffer
16291. Pisum jomardi.
16292. Triticum boeoticum.
16293. Triticum boeoticum thaoudar.
16294. Triticum dicoccum.
16295. Triticum giganteum.
16296. Triticum monococcum.
16297. Triticum monococcum hornemanni.
16298. Triticum polonicum.
16299. Triticum rigidum.
16300. Vigna glabra.
16301. Pisum elatius.
16302. Phaseolus multiflorus.

16303 to 16335.

From Kashgar, Chinese Turkestan. Received from Mr. Ellsworth Huntington, Kashgar, Chinese Turkestan, via Baku, Russia, thru the Chinese Amban of Khotan, and Mr. Macartney, British political agent at Kashgar, November 17, 1905.

"Khotan is a large, well-watered oasis, at an elevation of about 4,500 feet, at the foot of the Kuen Lun Mountains. Longitude 80°, latitude 37° N. In general, the climate is typically midcontinental. It may be likened to that of Colorado, tho drier and more extreme." (*Huntington.*)

16303. Vigna sinensis. **Cowpea.**

Lobia. A white bean.

16304. Brassica napus (?). **Turnip.**

Chamgu.

16305. (Undetermined.)

Usun.

16303 to 16335—Continued.

16306. Citrullus vulgaris. **Watermelon.**

Tarbuz.

16307. Coriandrum sativum. **Coriander.**

Gesnich.

16308. Allium sp. **Onion.**

Kuda.

16309. Foeniculum dulce (?). **Fennel.**

Siadana.

16310. Brassica sp. **Mustard.**

Kichi.

16311. Sesamum indicum. **Sesame.**

Kunjut.

16312. Brassica oleracea (?). **Cabbage.**

Baseh.

16313. Allium cepa (?). **Onion.**

Piaz.

16314. Panicum miliaceum. **Millet.**

Tarekh.

16315. Apium graveolens. **Celery.**

Chingseh.

16316. Agriophyllum gobicum. **Sulhir.**

Palak.

16317. Medicago sativa. **Alfalfa.**

Beda.

16318. Daucus carota. **Carrot.**

Zardek.

16319. Cucumis melo. **Muskmelon.**

Kaghun.

16320. Cicer arietinum. **Chick-pea.**

Narkhot.

16321. Linum usitatissimum. **Flax.**

Zighar. A variety of flax used only for oil.

16322. Cucumis sativus. **Cucumber.**

Khonga.

16323. Phaseolus radiatus. **Mung bean.**

Mash, or *Dal pea.*

16324. Carthamus tinctorius. **Safflower.**

Zarangzeh.

16325. Brassica sp. **Mustard.**

Zaghun. Extensively cultivated for oil.

16326. Pisum sp. **Pea.**

Puchek.

16327. Triticum vulgare. **Wheat.**

Bugdai.

16303 to 16335—Continued

16328. Oryza sativa. **Rice.**

Shal.

16329. Hordeum sp. **Barley.**

Arpa.

16330. Zea mays. **Corn.**

Konak.

16331. Cucurbita sp. **Squash** (?).

Kawa.

16332. Lagenaria vulgaris (?). **Gourd.**

Kapak.

16333. Cannabis sativa. **Hemp.**

Bang. Used for smoking.

16334. Iris ensata pabularia. **Iris.**

Chigitmak. "A species of iris said to grow in the dry desert sand or almost anywhere if once it gets rain enough to cause it to sprout. It is reported to be a good forage plant, both green and dry. Sheep are very fond of it, and other animals do not object to it." (*Huntington.*)

16335. Trigonella foenum-graecum. **Fenugreek.**

Shemshu.

16336 to 16470.

From Pullman, Wash. Received thru Mr. Byron Hunter, assistant agrostologist of the Department of Agriculture, November 14, 1905.

Seeds grown at the Agricultural Experiment Station at Pullman, Wash., together with others collected from various sources.

16336. Agropyron sp.

A promising grass.

16337. Agropyron divergens.

Collected in August, 1904, on the Moscow Mountains.

16338. Agropyron divergens.

Collected June 29, 1905, at Wawawai, Wash. (Agros. No. 579.)

16339. Agropyron elmeri.

Collected August 4, 1904, at Wawawai, Wash. (Agrost. No. 675.)

16340. Agropyron occidentale.

Crop of 1905.

16341. Agropyron occidentale.

Grown at Harlem, Mont.

16342. Agropyron pseudo-repens.

Crop of 1905.

16343. Agropyron spicatum.

Crop of 1905.

16344. Agropyron tenerum.

Crop of 1905. (Agrost. No. 211.)

16345. Agropyron tenerum.

Crop of 1904.

16346. Agropyron tenerum.

Crop of 1905. Grown from seed collected at Trinidad, Colo.

16347. Triticum violaceum.

Crop of 1905. (Agrost. No. 210.)

16348. Alopecurus castellanus.

Crop of 1903.

16349. Arrhenatherum elatius. **Tall meadow oat-grass.**

Crop of 1905. (Agrost. No. 2191.)

16350. Avena flavescens.

Crop of 1905. (Agrost. No. 2192.)

16351. Avena orientalis.

Crop of 1905. (Agrost. No. 1157.)

16352. Avena sativa. **Oat.**

Grown in 1905 from Argentine seed.

16336 to 16470—Continued.

16353. Bromus sp.

Crop of 1905. (Agrost. No. 245.)

16354. Bromus carinatus.

Collected at Wawawai, Wash., in 1904.

16355. Bromus carinatus.

Grown in 1905 from seed originally collected at Wawawai, Wash.

16356. Bromus carinatus.

Grown in 1904 at Chehalis, Wash. (Agrost. No. 609.)

16357. Bromus carinatus hookerianus.

Crop of 1905.

16358. Bromus carinatus hookerianus.

16359. Bromus inermis. **Smooth brome-grass.**

16360. Bromus marginatus.

Crop of 1904.

16361. Bromus marginatus.

"*Eight-dollar Grass.*" Grown at Selma, Oreg.

16362. Bromus marginatus.

Grown in 1905 from Portland, Oreg., seed.

16363. Bromus marginatus.

Crop of 1905.

16364. Bromus marginatus elatior.

16365. Bromus marginatus maritimus.

Crop of 1905. (Agrost. No. 2261.)

16366. Bromus marginatus pumpellianus.

Crop of 1905.

16367. Bromus polyanthus.

Gathered at Portland, Oreg., in 1904. (Agrost. No. 614.)

16368. Bromus polyanthus.

Crop of 1905. (Agrost. No. 319.)

16369. Bromus polyanthus paniculatus.

16370. Bromus sitchensis.

Grown in 1904 from seed gathered at Puyallup, Wash. (Agrost. No. 600.)

16371. Dactylis glomerata. **Orchard grass.**

Purchased from the C. H. Lilly Company, Seattle, Wash.

16372. Dactylis glomerata. **Orchard grass.**

Crop of 1905.

16373. Deschampsia caespitosa.

Crop of 1904.

16374. Elymus canadensis. **Wild rye.**

16375. Elymus virginicus submuticus.

Crop of 1902. (Agrost. No. 328.)

16376. Elymus virginicus submuticus.

Grown in 1905 from S. P. I. No. 16375.

16377. Festuca arundinacea.

16378. Festuca elatior. **Tall fescue.**

Grown from Kansas seed.

16379. Festuca hyb.

A hybrid from Mr. A. B. Leckenby, Union, Oreg.

16380. Festuca pratensis. **Meadow fescue.**

16381. Festuca reflexa.

16382. Lathyrus azureus.

Grown in 1905 from S. P. I. No. 11195.

16383. Lathyrus coccineus.

Grown in 1905 from S. P. I. No. 11196.

16384. Lathyrus ochrus.

Crop of 1905.

16336 to 16470—Continued.

16385. Lathyrus sativus. **Bitter vetch.**

Grown in 1905 from S. P. I. No. 11197.

16386. Lathyrus sativus. **Bitter vetch.**

Grown in 1905 from S. P. I. No. 11198.

16387. Lathyrus sativus. **Bitter vetch.**

Grown in 1905 from S. P. I. No. 11199.

16388. Lathyrus tingitanus. **Tangier scarlet pea.**

Grown in 1905 from S. P. I. No. 11220.

16389. Lathyrus tingitanus. **Tangier scarlet pea.**

Grown in 1905 from Agrost. No. 1548.

16390. Lolium bonariensis.

Grown in 1905 from Agrost. No. 2321.

16391. Lolium perenne. **Perennial rye-grass.**

From E. J. Bowen, San Francisco, Cal.

16392. Lolium perenne. **Perennial rye-grass.**

Grown in 1905 from seed secured in Holland.

16393. Lolium perenne. **Perennial rye-grass.**

Grown in 1905 from Agrost. No. 1981.

16394. Lolium perenne. **Perennial rye-grass.**

Grown in 1905 from Agrost. No. 5349. From Argentine seed.

16395. Lotus americanus. **Dakota vetch.**

From Cusick, Wash.

16396. Lotus americanus. **Dakota vetch.**

From Wenatchee, Wash.

16397. Lotus corniculatus. **Bird's-foot trefoil.**

Grown in 1905 from S. P. I. No. 11204.

16398. Lotus tetragonolobus. **Winged pea.**

Grown in 1905 from S. P. I. No. 10398.

16399. Medicago media. **Sand lucern.**

Crop of 1904.

16400. Medicago media. **Sand lucern.**

Crop of 1905.

16401. Medicago sativa. **Alfalfa.**

Grown by Mr. E. W. Downen, Pullman, Wash., in 1904.

16402. Medicago sativa. **Alfalfa.**

Turkestan alfalfa. Grown at Walla Walla, Wash., in 1904, from S. P. I. No. 991.

16403. Medicago sativa. **Alfalfa.**

Turkestan alfalfa. Grown in 1905 at Pullman, Wash., from seed obtained from Mr. M. Evans.

16404. Melilotus indicus.

Grown from Agrost. No. 1684.

16405. Melilotus macrostachys.

Grown from Agrost. No. 1553.

11406. Melilotus sulcata.

Grown from Agrost. No. 1161.

16407. Melica californica.

Grown in 1905 from Agrost. No. 1925.

16336 to 16470—Continued.

16408. PANICUM sp. **Bird seed.**
Crop of 1905.

16409. PANICUM sp. **Hungarian millet.**
Grown in 1905 from Agrost. No. 2355.

16410. PANICUM CRUS-GALLI.
Grown from Agrost. No. 1682.

16411. PANICUM CRUS-GALLI.
Crop of 1905.

16412. PANICUM MILIACEUM. **Broom-corn millet.**
Grown from Agrost. No. 2620.

16413. PANICUM MILIACEUM. **Broom-corn millet.**
Grown from Agrost. No. 2621.

16414. PANICUM MILIACEUM. **Broom-corn millet.**
Mixt yellow and white broom-corn millet. Grown from Agrost. No. 2625.

16415. PANICUM MILIACEUM. **Broom-corn millet.**
Grown from Agrost. No. 2626.

16416. PANICUM MILIACEUM. **Broom-corn millet.**
White. Grown from Agrost. No. 2627.

16417. PANICUM MILIACEUM. **Broom-corn millet.**
Grown from Agrost. No. 2628.

16418. PANICUM MILIACEUM. **Broom-corn millet.**
White seed; late variety. Grown from Agrost. No. 2629.

16419. PANICUM MILIACEUM. **Broom-corn millet.**
Grown in 1905 from seed obtained at Cusick, Wash.

16420. PANICUM MILIACEUM. **Broom-corn millet.**
White. Grown from seed obtained in Germany.

16421. PANICUM MILIACEUM. **Broom-corn millet.**
Grown from Austrian seed.

16422. PANICUM MILIACEUM. **Broom-corn millet.**
Austrian seed.

16423. PANICUM MILIACEUM. **Broom-corn millet.**
Grown in 1904 at Usk, Wash.

16424. PENNISETUM SPICATUM. **Pearl millet.**
Grown at Biggenden, Queensland. (Agrost. No. 2110.)

16425. PHALARIS ARUNDINACEA. **Reed canary grass.**
Grown from seed obtained from J. M. Thorburn & Co., New York City, N. Y.

16426 to 16432. PHALARIS CANARIENSIS. **Canary grass.**

16426.
Grown from Agrost. No. 1683.

16427.
Grown from Agrost. No. 2331.

16428.
Grown from Agrost. No. 2332.

16429.
Grown from Agrost. No. 2333.

16430.
Grown from Agrost. No. 2334.

16431.
Grown from Agrost. No. 2335.

16432.
From Genoa, Italy. Obtained at the Louisiana Purchase Exposition in 1904. (Agrost. No. 2361.)

16336 to 16470—Continued.

16433. Phleum pratense. **Timothy.**

Early.

16434. Phleum pratense. **Timothy.**

Stewart's Mammoth.

16435. Phleum pratense. **Timothy.**

Pasture.

16436. Pisum arvense. **Field pea.**

Grown from S. P. I. No. 1486.

16437. Pisum arvense. **Field pea.**

Grown from S. P. I. No. 1487.

16438. Plantago fastigiata.

Grown from seed originally obtained in Arizona.

16439. Plantago fastigiata.

Crop of 1904.

16440. Poa triflora.

Grown at Cusick, Wash.

16441. Spartina sp.

Grown at Cusick, Wash.

16442. Spartina cynosuroides.

16443. Stipa tenacissima. **Esparto grass.**

Grown from seed obtained from J. M. Thorburn & Co., New York, N. Y. (Agrost. No. 2216.)

16444. Trifolium pannonicum.

Grown from S. P. I. No. 9817.

16445. Trifolium pratense. **Red clover.**

Grown in 1904 by Mr. C. R. Widmer, Albany, Oreg.

16446. Trigonella foenum-graecum. **Fenugreek.**

Grown from Egyptian seed.

16447. Vicia sp. **Vetch.**

A variety similar to pearl vetch. Grown from Agrost. No. 2452.

16448. Vicia sp. **Vetch.**

Grown from S. P. I. No. 11200.

16449. Vicia sp. **Vetch.**

Grown at Ray, Wash.

16450. Vicia sp. **Vetch.**

Grown from S. P. I. No. 11199.

16451. Vicia sp. **Vetch.**

Grown from Agrost. No. 2454.

16452. Vicia atropurpurea. **Vetch.**

Grown from S. P. I. No. 12135.

16453. Vicia bithynica. **Vetch.**

Grown from S. P. I. No. 11230.

16454. Vicia cracca. **Vetch.**

Grown from S. P. I. No. 10283.

16455. Vicia cracca. **Vetch.**

Grown from Chinese seed.

16456. Vicia egyptica. **Vetch.**

16336 to 16470—Continued.

16457. Vicia faba. **Vetch.**

Grown from Agrost. No. 2463.

16458. Vicia fulgens. **Vetch.**

Grown from S. P. I. No. 11231.

16459. Vicia gigantea. **Vetch.**

Grown in 1904 at Clatskanie, Oreg. (Agrost. No. 613.)

16460. Vicia hirsuta(?). **Japan vetch.**

Grown from S. P. I. No. 9237.

16461. Vicia hirta. **Vetch.**

16462. Vicia lutea. **Vetch.**

Grown from Algerian seed.

16463. Vicia micrantha. **Vetch.**

Grown from Agrost. No. 999.

16464. Vicia narbonnensis. **Vetch.**

Grown from S. P. I. No. 11232.

16465. Vicia sativa alba. **Pearl vetch.**

16466. Vicia sativa. **Common vetch.**

Grown at Corvallis, Oreg.

16467. Vicia sativa alba. **Pearl vetch.**

Grown from seed from Mr. Henry Gilbrich, New Era, Oreg.

16468. Vicia sicula. **Vetch.**

Crop of 1904.

16469. Vicia sicula. **Vetch.**

Grown from Algerian seed.

16470. Vicia villosa. **Hairy vetch.**

Seed from Mr. Elliott.

16471. Andropogon halepensis. **Johnson grass.**

From St. Louis, Mo. Received thru D. J. Bushnell & Co., November 25, 1905.

16472 and 16473.

From Durban, Natal, South Africa. Received thru the Botanic Gardens, November 25, 1905.

16472. Arachis hypogaea. **Peanut.**

16473. Voandzeia subterranea. **Woandzu.**

16474. Lespedeza striata. **Japan clover.**

From Richmond, Va. Received thru T. W. Wood & Son, November 29, 1905.

16475. Lespedeza striata. **Japan clover.**

Received from the Office of Grass and Forage Plant Investigations of the Department of Agriculture, November, 1905. (Agrost. No. 1115.)

16476. Cucurbita sp. **Pumpkin.**

From Pretoria, South Africa. Received thru Prof. J. Burtt Davy, of the Transvaal Department of Agriculture, November 27, 1905.

Boer.

16477 to 16480. Garcinia spp.

From Sagua la Grande, Cuba. Received thru J. S. Montero & Bros., December 1, 1905.

16477. Garcinia cochinchinensis.

16478. Garcinia ferrea.

16479. Garcinia hanburyi.

16480. Garcinia indica.

16481. Ibervillea sp. (?).

From Mexico. Received thru Dr. J. N. Rose, of the United States National Museum, who collected the seed in the summer of 1905.

"A very interesting, attractive vine, which grows in very dry districts. Fruit red." (*Rose.*)

16482. Calyptrogyne dulcis.

From Santiago de las Vegas, Cuba. Received thru Departamento de Botánica, Estación Central Agronómica, November 28, 1905.

16483 to 16485. Arachis hypogaea. **Peanut.**

From Cat Island, S. C. Grown by Mr. J. H. Tull, special agent of the Department of Agriculture. Received November 20, 1905.

16483. Grown from S. P. I. No. 4253. From Cairo, Egypt.

16484. Grown from S. P. I. No. 9406. From Sao Paulo, Brazil.

16485. Grown from S. P. I. No. 11140. From Spain.

16486. Arachis hypogaea. **Peanut.**

From Japan. Received thru the Botanic Gardens, Durban, Natal, South Africa, December 2, 1905.

16487. Diospyros ebenum. **Sapote negro.**

From Manila, P. I. Received thru Mr. Thomas L. Lyon, of the Insular Bureau of Agriculture, December 2, 1905.

"Wood reputed good, but variable in color. One of the most attractive of our broad-leaved evergreens. Fruits astringent." (*Lyon.*)

16488. Vicia sativa alba. **Pearl vetch.**

From New Era, Oreg. Received thru Mr. Henry Gelbrich, December 5, 1905.

16489. Melilotus alba. **Sweet clover.**

From Birmingham, Ala. Received thru the Amzi Godden Seed Company, December 4, 1905.

16490 to 16494. Juncus spp. **Matting rush.**

Collected by Mr. J. H. Tull, special agent of the Department of Agriculture. Received December 5, 1905.

16490. Juncus effusus.

Collected on Cat Island, S. C.

16491. Juncus effusus conglomeratus.

Collected near Kinston, N. C.

16492. Juncus effusus conglomeratus.

Collected on Black River road, near Georgetown, S. C.

16493. Juncus effusus conglomeratus.

Collected on Cat Island, S. C.

16494. Juncus effusus conglomeratus.

Collected near Newbern, N. C.

16495 to 16505.

From the White House Propagating Gardens, Washington, D. C. Received December 5, 1905.

A collection of ornamentals.

16495. Calathea ornata majestica.

16496. Xanthosoma lindeni.

16497. Calathea pulchella.

16498. Calathea vandenheckei.

16499. Calathea intermedia.

16500. Calathea warscewiczii.

16501. Ischnosiphon hirsuta.

16502. Maranta wallisi.

16503. Maranta amabilis.

16504. Homalomena wallisi.

16505. Calathea (?) sp.

16506. Aralia cordata. **Udo.**

From Waseda, Tokyo, Japan. Received thru J. Ikeda & Co., December 5, 1905.

16507. Panicum sp.

From Pretoria, South Africa. Received thru Prof. J. Burtt Davy, of the Transvaal Department of Agriculture, December 5, 1905.

16508. Medicago sativa. **Alfalfa.**

From Amasia, Turkey. Received thru Mr. H. Caramanian, November 25, 1905.

16509 to 16540.

From Nancy, France. Received thru Victor Lemoine & Son, December 4, 1905.

16509. Anemone japonica.

16510. Anemone japonica.

16511. Deutzia myriantha.

16512. Deutzia vilmorinae.

16513. Philadelphus lemoinei.

16514 to 16540. Phlox decussata. **Perennial phlox.**

Named varieties.

16541 to 16762. Paeonia spp. **Peony.**

From Chenonceaux (Indre-et-Loire), France. Received thru Monsieur A. Dessert, December 2, 1905.

16541 to 16642. Named varieties of the Chinese herbaceous section.

16643 to 16659. Named varieties of the European herbaceous section.

16660. Paeonila anomala (or Smouthii).

16661. Paeonia tenuifolia.

16662. Paeonia tenuifolia flore pleno.

16663 to 16759. Paeonia moutan. Named double varieties.

16760 to 16762. Paeonia moutan. Named single varieties.

16763 and 16764.

From the Office of Gardens and Grounds, Department of Agriculture. Received December 8, 1905.

16763. Calathea sp.

Rough-pubescent petiole basal; green thruout.

16764. Maranta sp.

Near *Maranta arundinacea*, but with side shoots on culms.

16765 to 16769.

From the White House greenhouse, Public Buildings and Grounds, Washington, D. C. Received December 8, 1905.

16765. Maranta splendida.

16766. Calathea arrecta.

16767. Calathea makoyana.

16768. Calathea roseo-picta.

16769. Calathea undulata.

16770. Zea mays. **Sweet corn.**

From North Clarendon, Vt. Received thru Mr. D. Dana Hewitt, December 11, 1905.

White Malakof. Grown from S. P. I. No. 13256. (Lot "A" selected from No. 16772.)

16771. Medicago denticulata. **Bur clover.**

From San Francisco, Cal. Received thru the Jessup-Wheelan Company, December 11, 1905.

16772. Zea mays. **Sweet corn.**

From North Clarendon, Vt. Received thru Mr. D. Dana Hewitt, December 11, 1905.

White Malakof. Grown from S. P. I. No. 13256.

16773 to 16780.

From St. Louis, Mo. Received thru Mr. Fred Mueller, of the Missouri Botanical Gardens, December 11, 1905.

16773. Alocasia macrorhiza variegata.

From Ceylon.

16774. Alocasia odora.

From East Indies.

16775. Colocasia sp.

From Mexico.

16776. Colocasia antiquorum euchlora.

From India.

16777. Colocasia indica.

16778. Xanthosoma sp.

From Cuba.

16779. Xanthosoma violaceum.

From West Indies.

16780. (Undetermined.)

16781 to 16784. Zea mays. **Sweet corn.**

From North Clarendon, Vt. Received thru Mr. D. Dana Hewitt, December 11, 1905.

White Malakof.

16781. Grown from S. P. I. No. 13357

16782. Grown from selection "B" of S. P. I. No. 13256.

16783. Grown from selection "G" of S. P. I. No. 13256.

16784. Grown from selection "C" of S. P. I. No. 13256.

16785. Hibiscus sabdariffa. **Roselle.**

From Mayaguez, P. R. Received thru the Porto Rico Experiment Station, December, 1905.

16786. Eucalyptus corymbosa. **Bloodwood.**

From Bowen, North Queensland, Australia. Received thru Mr. William Pettigrew, of the Queensland Acclimatization Society, December 6, 1905.

"One of the numerous species of Australian eucalyptus. A tree of medium size, with persistent flaky bark, often reported as stunted or shrubby in appearance, but frequently attaining a height of 150 feet and a trunk diameter of 3 feet. It is restricted to the warmer and moister coast regions of northeast Australia, and, to judge by its absence in the interior, could hardly be expected to grow in a region subject to frost or extremes of dryness. The tree furnishes a wood that is easily worked when fresh, but exceedingly hard when dry. The presence of kino makes it unsuitable for lumber or fuel, but also serves to make it very durable underground and resistant to white ants; hence it is very valuable for railroad ties, posts, culverts, for paving, and for other uses in underground situations. Fence posts of this material are reported to have lasted for forty years in Australia. The bark yields 28 per cent tannic acid and the leaves about 18 per cent. The creamy white flowers of this tree contain a large amount of nectar and are much visited by bees. The tree is also one of the sources of the kino of commerce." (*McClatchie.*)

16787. GARCINEA SPICATA. **Fukuji tree.**

From Riu Kiu Islands, Japan. Received thru Mr. H. E. Amoore, December 11, 1905.

"An ideal wind-break." (*Amoore.*)

16788. NICOTIANA TABACUM. **Tobacco.**

From Morrinhos, State of Goyaz, Brazil. Selected by Mr. Antonio Borges Sampaio, of Uberaba, Minas-Geraes, and sent in by Dr. H. M. Lane, of Sao Paulo, Brazil. Received December 15, 1905.

"The famous *Morrinhos* tobacco. The tobacco grown in Sao Paulo and Goyaz is probably from seed brought from the Orient by the early Portuguese settlers, who took great pains to keep it pure. Goyaz is located in the mountainous region of Brazil, about 700 miles northwest of Rio de Janeiro, in latitude 16° S., where the mean annual temperature is 80°, with a maximum of 104° and a minimum of 25°." (*Lane.*)

16789 to 16796.

From Hangchow, China. Received thru Mr. Frederick D. Cloud, United States vice-consul, December 15, 1905.

16789. GLYCINE HISPIDA. **Soy bean.**

Yellow. An oil bean.

16790. GLYCINE HISPIDA. **Soy bean.**

Black. An excellent table bean.

16791. PHASEOLUS sp. **Bean.**

16792. ANDROPOGON SORGHUM. **Sorghum.**

16793. PHASEOLUS RADIATUS. **Mung bean.**

16794. VIGNA SESQUIPEDALIS (?).

"Grow with long pod and bear well. Used as a vegetable." (*Cloud.*)

16795. VIGNA SINENSIS (?). **Cowpea.**

"Very different from preceding. More prolific, shorter pod, and a better eating bean." (*Cloud.*)

16796. GLYCINE HISPIDA. **Soy bean.**

Black.

"All of these varieties are largely grown in China and, as in the case of the yellow soy bean, are very valuable. The black soy bean is extensively grown in the north for forage purposes and constitutes the principal article of food for horses, donkeys, and cattle. It is also a good table bean. This bean mixed with '*kaoliang*' (sorghum) seed, chopped grass, or straw, with a little bran, makes the very best horse feed. Perhaps the '*kaoliang*' is the most highly prized of all forage plants grown in China. No part of the plant goes to waste. Two or three weeks before the plant matures and the seed is ripe the farmer strips nearly all the blades from the plant, ties them in bundles, allows them to cure in the sun for a few days, and then stacks them away

16789 to 16796—Continued.

indoors. All thru the winter these blades are keenly relished by horses and donkeys. Then the seeds are gathered, combed out, and marketed. Several varieties of alcohol and wines are made from these seeds, and the deadly native drink 'sam-shu'—at least one variety of it—is made from '*kaoliang*' seed. The seed makes excellent feed for stock of all kinds. The long stalks are thrown on the thrashing floor, rolled flat by heavy stone rollers, carefully cleaned of all particles of pith, and woven into a great variety of mats and matting, suitable for use on floors, for window shades, or for the roofs of native houses and sheds. These stalks are also extensively used for fuel by the farming class. It is a most valuable crop and may be found thruout all the northern provinces. Not grown much as far south as Hang-chow.

"The yellow bean (16789) is the 'bean-cake' bean so extensively grown in the Manchurian provinces and is a most valuable crop. May be grown southward, but flourishes best in colder latitudes." (*Cloud.*)

INDEX OF COMMON AND SCIENTIFIC NAMES.

Abyssinian seeds, 11039 to 11119, 12371 to 12393.
Acacia sp., 12781.
    aneura, 10475.
    baileyana, 12790.
    cultriformis, 15684.
    cunninghamii, 15683.
    elongata, 12791.
    linearis, 12792.
    longifolia, 11743.
    lunata, 12793.
    montana, 10476.
    neriifolia, 10477, 15685.
    prominens, 11744.
    trinervata, 12794.
Acer carpinifolium, 13993.
    circinnatum, 15932.
    macrophyllum, 12236.
    myabei, 13801.
Achras sapota, 11534.
Aconitum napellus, 12410, 12411, 12427, 12428.
Actinidia sp., 11629, 11630.
Adenocarpus frankenioides, 10727.
Adonis amurensis, 15781.
Aegilops speltoides, 16276.
    squarrosa, 16254.
Afzelia quanzensis, 12360.
Agapanthus umbellatus 12239, 13803.
Agaricus sp., 13078, 13134.
Agave sp., 16159, 16198, 16206.
    maculata, 11689.
Agriophyllum gobicum, 16316.
Agropyron sp., 16336.
    divergens, 16337, 16338.
    elmeri, 16339.
    occidentale, 13441 to 13443, 13504, 16340, 16341.
    pseudo-repens, 16342.
    spicatum, 16343.
    tenerum, 11129, 13092, 16344 to 16346.
Agrostis sp., 13877.
    alba, 11130, 11640.
    asperula, 14840.
Akee. See *Blighia sapida*.
Alchornea ilicifolia, 10478.
Aleurites cordata, 10410, 13104.
Alfalfa, (Algeria), 12803.
    (Arabia), 12992.
    (Argentina), 12549.
    (Ecuador), 14972.
    (France), 14496, 14497.
    (Italy), 13738, 13739, 13742 to 13745, 13751, 13753 to 13755, 13757 to 13759.
    (Mexico), 11651, 11652.
    (Russia), 10232 to 10235, 13857, 13858.
    (Tunis), 12846, 12847.
    Turkestan, 14786.
    See also *Medicago* spp.
Algarobillo. See *Caesalpinia brevifolia*.
Allium sp., 16308.
    cepa, 10988, 11761, 11762, 12719, 12720, 12732, 13088, 13859, 16313.
    fistulosum, 12703.
Almond. See *Amygdalus communis*.
Alnus firma, 10529.
    incana, 10530.
    japonica, 10528.
    maritima, 12802.
Alocasia sp., 15789, 15889.
    cuprea, 15678.
    macrorhiza, 15413.
        variegata, 16773.
    odora, 16774.
Aloe dichotoma, 11643.
Alopecurus castellanus, 16348.
Alphitonia ponderosa, 14429.
Alpinia caerulea, 10479.
Alsike. See *Trifolium hybridum*.
Althaea rosea, 13575, 13594, 13603, 13604.
Alyssum maritimum, 12964.
Amaryllidaceae, 16141, 16148, 16202.
Amatungulu. See *Carissa arduina*.
Ampelopsis veitchii purpurea, 11564.
Amphypterygium, 16207.
Amygdalus communis, 10338, 10558 to 10562, 12552, 12822 to 12831, 15831 to 15837.
    hyb., 11255.
    persica, 10335 to 10337, 10457, 11777, 15753, 15754, 15935.
Anacardium occidentale, 12809.
Ananas sativus, 11010, 11011, 11675, 14452.
Andropogon sp., 13880, 13882.
    affinis, 14896.
    contortus, 13873.
    eucomus, 13889.
    halepensis, 11131, 16471.
    sericeus, 15949.
    sorghum, 10327, 10612, 11058 to 11067, 11082 to 11085, 11119, 11132 to 11138, 11164, 11371, 11793, 12371 to 12374, 13316 to 13318, 13565, 14500 to 14775, 15825, 16792.

Anemone alpina sulphurea, 12994.
  japonica, 16509, 16510.
Anise. See *Pimpinella anisum.*
Anona sp., 13137.
Anthericum sp., 16143.
Anthistiria ciliata, 13434.
Anthoxanthum odoratum, 11139, 13359.
Antirrhinum majus, 12987, 12988.
Apera arundinacea, 13623.
Apio. See *Arracacia esculenta.*
Apium graveolens, 10995, 16315.
Apple (Crimea), 10345 to 10348.
  Misket, 10525, 13087.
  Russian, 10261.
  (Turkey), 13056.
  See also *Pyrus malus.*
Apricot. See *Prunus armeniaca.*
  Siberian. See *P. siberica.*
Aquilegia sp., 13624, 13625, 13627, 13628, 13645, 13722, 13723.
  coerulea, 13020, 13021, 13640, 13726.
  californica, 13024.
  canadensis, 13022.
  caryophylloides, 13637.
  chrysantha, 13018, 13019, 13638.
  clematidea hybrida, 13639.
  ecalcarata, 13626.
  flabellata, 13641.
  glandulosa, 13023, 13642.
  helenae, 13706.
  skinneri, 13289, 13644.
  stuarti, 13290.
  truncata, 13643.
  vulgaris compacta, 13660.
Arachis hypogaea, 10622, 11140, 11532, 12814, 14961, 14962, 15782 to 15787, 16161 to 16164, 16233 to 16236, 16472, 16483 to 16486.
Aralia cordata, 12140, 12452, 16506.
  racemosa, 16231.
Aristida sp., 13879, 13892, 13899, 15334.
Armeria formosa hyb., 13694.
Arracacia esculenta, 15374.
Arrhenatherum elatius, 11141, 11143, 16245, 16255, 16349.
Artemisia argentea, 10676.
Artichoke. See *Cynara scolymus.*
  Chinese. See *Stachys sieboldii.*
Arundinaria simoni, 11641.
Arundinella ecklonii, 13886.
Ash. See *Fraxinus* sp.
Asparagus crispus, 14984.
  duschesnii, 13319.
  virgatus, 11733, 12898.
Asphodelus ramosus, 10675.
Astrebla triticoides, 15950.
Atriplex confertifolia, 13556.
  coronata, 13553 to 13555, 13557.
  holocarpa, 12778, 15947.
  leptocarpa, 15948.
  nummularia, 12777.
  semibaccata, 11142, 12735.
Atropa belladonna, 12900.
Avena sp., 13812, 13968.
  brevis, 16277.
Avena flavescens, 16350.
  hirsuta, 16278.
  ludoviciana, 16279.
  orientalis, 16280, 16351.
  planiculmis, 14841, 16281.
  sativa, 10183 to 10193, 10269, 10271, 10278, 10279, 10321, 10330, 10354 to 10359, 10455, 10624, 11144 to 11151, 11655, 11722, 12133, 12303, 12877 to 12882, 13090, 13091, 13576, 13577, 14802, 15655, 15797, 15798, 16856 to 15864, 16352.
  strigosa, 16282.
Avocado. (Canary Islands), 16170.
  (Florida), 12933 to 12937, 13729 to 13731, 15656.
  (Guatemala), 10978, 13292.
  (Hawaii), 10615 to 10620.
  (Mexico), 14435, 14889, 14890.
  (Natal), 11724.
  See also *Persea gratissima.*
Bactris major, 14458.
Balsamorhiza sp., 11676.
Balsam-root. See *Balsamorhiza* sp.
Bamboo. See *Arundinaria simoni*, *Bambusa striata*, *Bambusa vulgaris*, and *Phyllostachys* spp.
Bambusa striata, 12757.
  vulgaris, 14447.
Banana. See *Musa sapientum.*
Barberry. See *Berberis* sp.
Barberton daisy. See *Gerbera jamesoni.*
Barley. (Central Asia), 16329.
  (England), 10360 to 10363.
  (Finland), 10270.
  (Germany), 13346.
  Hanna, 10402, 11622, 12125, 12993, 15867.
  (India), 14964, 14965.
  (Minnesota), 10674.
  (Norway), 13578.
  Oderbrucker, 10754.
  Russian, 10219 to 10222.
  Swedish, 10275, 10276, 10583 to 10586.
  See also *Hordeum* spp.
Barringtonia alba, 10480.
Bean, broad, 10406, 10411 to 10448, 10535 to 10543, 10991, 13779 to 13785.
  horse, 10724, 10753, 10962, 11697, 11759, 13784, 13785, 14468, 14880, 14881, 15428, 15429.
  soy. See *Glycine hispida.*
  velvet. See *Mucuna utilis.*
  See also *Phaseolus* spp. and *Vicia* spp.
Beet, (Sicily), 10628 to 10630.
  sugar, 11152 to 11163, 11237 to 11251, 11355 to 11368, 12394, 12744, 12745, 12918, 13952 to 13966.
  See also *Beta* spp.
Begonia sp., 10465, 10575, 11345, 11597 to 11599, 11692, 12733.
Belamcanda punctata, 13236.
Bellflower, Chilean, 14948.
Bellis perennis, 13703.

Berberis sp., 13347.
amurensis, 13351.
fremonti, 12242.
sieboldii, 13353.
sinensis, 13352, 13976.
thunbergii, 13977, 13978.
vulgaris, 13979 to 13985.
Berseem. See *Trifolium alexandrinum.*
Beschorneria bracteata, 15751.
Beta cicla, 10531.
maritima, 10629, 10630.
vulgaris, 10628, 10989, 11152 to 11163, 11237 to 11251, 11355 to 11368, 12394, 12744, 12745, 12918, 13952 to 13966, 14804.
Bidens heterophylla, 14488.
Bird's-foot trefoil. See *Lotus corniculatus.*
Bitoom. See *Pistacia atlantica.*
Black jube. See *Diospyros lotus.*
Blandfordia flammea, 10481.
Blennodia lasiocarpa, 10482.
Blighia sapida, 10557, 16224.
Bloodwood. See *Eucalyptus corymbosa.*
Bloomeria aurea, 13818.
Boltonia glastifolia, 13665.
Bosea yervamora, 10677, 10728.
Bossiaea rhombifolia, 12795.
Bouteloua curtipendula, 13566.
Brachypodium pinnatum, 16256.
Brassica sp., 10245 to 10247, 11081, 15811, 15813, 16310, 16325.
alba, 10982, 10983.
chinensis, 14957.
napus, 10243, 10244, 11165, 11684, 13733, 13787 to 13793, 16193, 16304.
nigra, 12756.
oleracea, 12813, 16312.
botrytis, 13000.
pe-tsai, 10981, 10984, 10994, 10997, 15812.
rapa, 12727, 12728, 15315 to 15320.
Brome-grass. See *Bromus* spp.
Bromus sp., 15956 to 15959, 16353.
adoensis, 15960.
alopecurus, 15961.
altissimus, 15962.
andinus, 14842, 15963.
angustifolius, 15964, 15965.
arduennensis, 15966 to 15969.
villosus, 15970.
arenarius, 15971.
arvensis, 15972.
asper, 15973.
biebersteinii, 15974.
brachystachys, 15975.
breviaristatus, 15976, 15977.
brizaeformis, 15978.
canadensis, 15979 to 15983.
carinatus, 15984, 16354 to 16358.
hookerianus, 13444, 13445.
ciliatus, 15985 to 15994.
commutatus, 15995, 15996.
condensatus, 15997.
confertus, 15998.
congestus, 15999.
Bromus crinitus, 16000.
danthoniae, 16001.
diandrus, 16002.
erectus, 16003, 16283.
laxus, 16004.
transilvanicus, 16005.
villosus, 16006.
fibrosus, 16007.
fimbriatus violaceus, 16008, 16009.
giganteus, 16010.
triflorus, 16011.
grossus, 16012.
gussoni, 16013, 16014.
hookerianus, 16015.
hordeaceus, 16016.
glabrescens, 16017.
inermis, 10226, 11166, 13446, 13795, 15884, 16018 to 16022, 16171 to 16174, 16359.
intermedius, 16023.
interruptus, 16024.
japonicus, 16025, 16026.
kalmii, 16027, 16028.
krausei, 16029, 16030.
laevipes, 16031, 16032.
laxus, 16033 to 16035.
longiflorus, 16036 to 16038.
macranthus, 16039.
macrostachys, 16040, 16041.
lanuginosus, 16042.
madritensis, 16043 to 16045.
delilei, 16046.
marginatus, 13370, 13447, 13505, 16047, 16048, 16360 to 16366.
maximus gussoni, 16049.
mollis, 16050, 16051.
glabratus, 16052.
lloydianus, 16053.
thominii, 16054.
multiflorus, 16055.
pacificus, 15875.
parviflorus, 16056.
patulus, 16057, 16058.
manus, 16059
pendulus, 16060.
pitensis, 16061, 16062.
polyanthus, 16367, 16368.
paniculatus, 13448, 16369.
porteri frondans, 16063.
pubescens, 16064.
pumpellianus, 16065, 16066.
pungens, 16067.
ciliatus, 16068.
púrgans, 16069 to 16074.
purpurascens, 16075, 16076.
racemosus, 16077 to 16084.
richardsoni, 16085.
rigidus, 16086.
rubens, 16087, 16088.
schraderi, 16089, 16090.
secalinus, 16091, 16092.
multiflorus, 16093.
segetum, 16094.
sitchensis, 16370.
squarrosus, 16095 to 16101.
villosus, 16102.

Bromus squarrosus wolgensis, 16103.
  stenophyllus, 16104.
  sterilis, 16105.
  tacna, 16106 to 16108.
  tectorum, 16109, 16110.
  trinii, 16111.
  unioloides, 11167, 16112 to 16122.
    willdenowii, 16123.
  valdivianus 16124.
  variegatus, 16125.
  vestitus, 16126.
  virens, 16127.
  willdenowii, 16128.
Broom corn. See *Andropogon sorghum.*
Brucea sumatrana, 11681.
Brunonia australis, 10483.
Bryonia alba, 12440.
  dioica, 12441.
Buckwheat. See *Fagopyrum* spp.
Butternut. See *Juglans cinerea.*
Bystropogon origanifolius, 10678, 10729.
Cabbage. See *Brassica oleracea.*
Cacao. See *Theobroma cacao.*
Caesalpinia sp., 14437.
  brevifolia, 10631, 11792.
  kauaiensis, 14425.
Caladium sp., 15378.
  esculentum 13293 to 13297.
Calamagrostis hyperborea, 13449.
Calathea sp., 16505,16763.
  arrecta, 16766.
  intermedia, 16499.
  makoyana, 16767.
  ornata majestica, 16495.
  pulchella, 16987.
  roseo-picta, 16768.
  undulata, 16769.
  vandenheckei, 16498.
  warscewiczii, 16500.
Calendula officinalis, 12979, 12980.
Calla. See *Richardia africana.*
Calliandra grandiflora, 11593, 11688.
Calliopsis. See *Coreopsis.*
Callitris calcarata, 15686.
  robusta, 15687.
Calophyllum calaba, 11653.
  hasskarlii, 11021.
  inophyllum, 10463, 12110.
  kunstleri longifolium, 11022.
  spectabile, 11023, 11024, 11025.
  venulosum, 11026.
Calyptrogyne dulcis, 16482.
Campanula amabilis, 13721.
  glomerata acaulis, 13707, 13720.
  media, 13025, 13026, 13591.
  pyramidalis, 13286, 13288, 13589, 13590.
Camphor. See *Cinnamomum camphora.*
Canarium album, 11271.
Cannabis sativa, 10241, 10242, 10281, 10979, 12849, 16332.
Cape gooseberry. See *Physalis* spp.
Capparis mitchellii, 10485.
Capriola dactylon, 11169, 13878, 15779.
Capsicum annuum, 10392 to 10396, 10755, 10756, 11639, 11741, 11742, 14484, 14485.
Capsicum frutescens, 11108.
Caragana arborescens, 12913, 15475.
  microphylla, 12912.
Carica papaya, 13103, 14449.
Carissa arduina, 11734, 13239, 13967.
Carpodetus serratus, 11745.
Carthamus tinctorius, 11115, 16324.
Carum ajowan, 12431.
  carvi, 12414, 12901.
  gairdneri, 12932, 16223.
Cascara sagrada. See *Rhamnus purshiana.*
Cashew nut. See *Anacardium occidentale.*
Casimiroa edulis, 14454.
Cassava. See *Manihot* sp.
Cassia angustifolia, 12442.
Cassinnia theodorei, 10484.
Castanea crenata, 12773, 13130.
  sativa, 13131.
  vesca, 12681.
Castanospora alphandi, 10486.
Castilla costaricana. 11657.
  elastica, 10975, 14450.
Castor oil. See *Ricinus* spp.
Casuarina stricta, 15688.
  suberosa, 12796.
  torulosa, 13689.
Catispa, 16134.
Cauliflower. See *Brassica oleracea botrytis.*
Cebadilla. See *Schoenocaulon officinale.*
Cedar, giant. See *Thuja gigantea.*
Cedar of Lebanon. See *Cedrus libani.*
Cedrela odorata, 11769.
Cedronella canariensis, 10730.
Cedrus libani, 11258.
Celery. See *Apium graveolens.*
Celtis paniculata, 10487.
Centaurea sp., 11114.
  calcitrapa, 10679.
  cyanus, 12977.
Centranthus ruber, 13608, 13609.
Centrosema plumieri, 15852.
Cephalaria tatarica, 13360, 13361, 13852.
Cerastium biebersteinii, 13612.
Cercidiphyllum japonicum, 11624.
Cereus validus, 12404.
Ceruella, 14434, 14456.
Chaetochloa sp., 13887, 13911, 13919.
  aurea, 13910.
  glauca, 14905.
  italica, 10613, 11168, 11220, 11496, 15827.
  nigrirostre, 13912.
  pennisetum, 13914.
Chamaedorea sp., 11012 to 11017.
Chayote. See *Sechium edule.*
Cheirodendron gaudichaudii, 14423.
Chenopodium anthelminticum, 12908.
Cherry, flowering. See *Prunus pseudocerasus.*
  Japanese bush, 15810.
  Mexican, 11636.
  Russian, 10260, 10580 to 10582, 11034.
  See also *Prunus* spp.
Chestnut. See *Castanea* spp.
Chick-pea. See *Cicer arietinum.*
Chilopsis saligna, 15807.

Chloris sp., 15355.
truncata, 10488.
virgata, 13895, 13901, 15337.
elegans, 15340.
Chrysanthemum anethifolium, 12872.
frutescens, 10681, 10731.
leucanthemum hyb., 13313 to 13315.
Chrysopsis hispida, 11771.
Cicer arietinum, 10973, 10974, 11095, 11109, 11110, 11170, 11634, 12393, 13362 to 13369, 16320.
Cineraria populifolia argentea, 10680.
Cinnamomum camphora, 13808, 14464, 14884.
Ciruela, or Ciruella. See *Spondias* sp.
Citrange. See *Citrus* hyb.
Citrullus vulgaris, 10249, 12718, 12771, 15758, 15764, 15766, 15929, 15930, 16306.
Citrus sp., 12141, 13263.
aurantium, 10970, 12687 to 12690, 12692.
australasica, 14993.
bigaradia, 12691.
decumana, 11661 to 11673, 14907.
hyb., 13002 to 13006.
limetta, 10365.
limonum, 12686.
Clematis sp., 11539 to 11563, 13929 to 13932, 13936 to 13939, 13941 to 13945.
coccinea, 13927.
davidiana, 13863.
flammula, 13925.
fortunei, 11522.
indivisa, 13926.
integrifolia durandii, 13946.
jackmani, 11558 to 11560, 13933, 13934.
lilacina floribunda, 13935.
reticulata, 11557.
standishi, 13940.
Clethra arborea, 10732.
Clianthus dampieri, 15953.
Clitoria ternatea, 13862.
Clivia miniata. 15676.
Clover, bur. See *Medicago denticulata* and *M. maculata*.
crimson. See *Trifolium incarnatum*.
(England), 13772 to 13777.
(France), 14493 to 14495.
(Greece), 12927 to 12929.
(Italy), 13734 to 13737, 13740, 13741, 13746 to 13749, 13752, 13756, 13770, 13771.
(Japan). See *Lespedeza striata*.
(New Zealand), 12890, 12891.
(Norway), 13581.
red. See *Trifolium pratense*.
Russian, 10254, 10532 to 10534, 10563 to 10567, 10577, 10626, 10627.
sweet. See *Melilotus* spp.
(Uganda), 10352.
white. See *Trifolium repens*.
wild Russian, 10254.
See also *Trifolium* spp.
Cochlearia armoracia, 10462, 10576.
officinalis, 15849.
Coffea sp., 11078, 11354, 11504, 12380 to 12382.
zanguebariae, 12897.
Colchicum autumnale, 12436.
Colocasia sp., 13086, 15381, 15382, 15395, 16775.
antiquorum esculentum, 15372, 15373, 15941.
euchlora, 16776.
fontanesii, 15797.
illustris, 15796.
indica, 16777.
Combretum loeflingii, 10489.
Commelina coelestis, 13614.
Conium maculatum, 12902.
Convolvulus sp., 10623.
althaeoides, 10682.
floridus, 10683.
Cordyline australis, 15690.
obtecta, 15691.
stricta, 15692.
Coreopsis sp., 12972.
coronata, 12976.
drummondii, 12974.
grandiflora, 12973.
lanceolata, 12971, 13629, 13630.
tinctoria, 12975.
Coriandrum sativum, 11077, 11101, 12903, 16307.
Corn (Central Asia), 16330.
(India), 14971.
(Mexico), 14459.
(Russia), 16190.
sweet, 10400, 10401, 12557 to 12563, 12697, 13143 to 13153, 13570, 16770, 16772, 16781 to 16784.
(Turkey), 15775.
See also *Zea mays*.
Cornus kousa, 12755.
macrophylla, 13994, 13995.
Coronilla varia, 10252.
Corylus avellana, 10343, 10344, 12833, 12834.
Cosmos bipinnatus, 12989.
Cotoneaster angustifolia, 13242.
Cotton (Australia), 14885 to 14887.
(Guatemala), 13094 to 13101.
(Peru), 13583 to 13585, 14801, 14870, 14945, 14946.
tree. See *Gossypium arboreum*.
wild, 13079, 13238.
See also *Gossypium* spp.
Cowpea. See *Vigna sinensis*.
Craspedia richea, 10490.
Crataegus sp., 12548.
Crocus sp., 15441, 15442.
Crucianella stylosa, 13616.
Cucumis sp., 11774.
melo, 10248, 10553 to 10556, 11796, 12108, 12109, 12669, 12770, 13341 to 13345, 13355, 15672, 15755 to 15757, 15765, 15776, 16319.
sativus, 12717, 12863, 16322.

Cucurbita sp., 10310, 12704, 12729, 12749, 12750, 12843 to 12845, 15670, 15671, 15816, 15817, 15937, 16331, 16476.
melanosperma, 14874.
Cupania sapida. See *Blighia sapida.*
Curcuma amada, 16194.
longa, 16196.
Custard apple, wild, 13137.
Cydonia sp., 13158.
Cynara scolymus, 12862, 15945, 15946.
Cyperus sp., 14483.
papyrus, 10568, 12710.
Cyphomandra betacea, 12758.
Cytisus glabratus, 10684.
palmensis, 10685, 10734.
proliferus albus, 15927.
scoparius, 15851.
Dactylis aschersoniana, 14843.
glomerata, 11171, 12895, 15668, 16371, 16372.
Dahlia sp., 10572, 12367, 12449, 12450, 12564, 13283, 13727.
chisholmi, 10573.
imperialis, 14995.
merckii, 12738.
variabilis, 13705.
Danthonia semiannularis, 15952.
Dasylirion sp., 16205.
Date. See *Phoenix dactylifera.*
Date plum. See *Diospyros lotus.*
Daucus carota, 14805, 16318.
Davidia involucrata, 12137, 16208.
Delphinium sp., 12769.
ajacis hyacinthiflorum, 13661.
chinense, 13595.
elatum, 13104, 13685.
formosum, 13015, 13016, 13597.
grandiflorum, 13012, 13013, 13596.
hyb., 13017, 13714.
imperiale, 13662.
staphisagria, 10686, 10735, 12420, 12433.
sulphureum, 13598.
Deschampsia caespitosa, 16373.
Desert willow. See *Chilopsis saligna.*
Deutzia myriantha, 16511.
vilmorinae, 16512.
Dianella tasmanica, 10491.
Dianthus barbatus, 13587, 13588, 13600 to 13602, 13670 to 13673, 13695.
barbatus × *D. chinensis*, 13647.
caryophyllus, 13699 to 13702, 13708, 13709.
chinensis, 13682, 13684.
elatum, 13683.
heddewigii, 13008.
imperialis, 13659.
plumarius, 13657, 13716, 13717, 13719.
Dieffenbachia sp., 15763.
seguine, 15679.
Digitalis canariensis, 10687, 10736.
grandiflora, 13592.
lutea grandiflora, 13593.
purpurea, 12699, 13009 to 13011.
Dillwynia cinerascens, 10492.
Dioscorea sp., 10590 to 10593.
divaricata, 10311, 10312.
Diospyros ebenum, 16487.
kaki, 13819 to 13851.
lotus, 15780.
Diplopappus chrysophyllus, 13712.
Dodecatheon meadia, 12776.
Dodonaea triquetra, 10493.
viscosa, 12797, 14430.
Doekoe. See *Lansium domesticum.*
Dolichos biflorus, 13371, 13372.
lablab, 13373 to 13376.
uniflorus, 12752.
Doum palm. See *Hyphaene crinita.*
Dracaena aurea, 14427.
draco, 10688.
Dracontium asperum, 15805.
Dracunculus canariensis, 10689.
Durian. See *Durio zibethinus.*
Durio zibethinus, 15886.
Dysoxylon muelleri, 10494.
Ecballium elaterium, 12421, 12426.
Echeandia sp., 16154.
paniculata, 13281.
Echinacea sp. × *E. peleanthus*, 13725.
angustifolia, 12424, 12425.
Echinocystis sp., 13816, 13817.
Echinops ritro, 13619.
Echium formosum, 10690.
simplex, 10691.
strictum, 10692.
Edgeworthia gardneri, 12142.
Eecha, 13142.
Ehrharta stipoides, 14901.
Einkorn. See *Triticum monococcum.*
Elaeagnus angustifolia, 10371, 10372.
Elaeocarpus cyaneus, 12798.
Elaeodendron curtipendulum, 10495.
Eleusine coracana, 11100, 12390.
tocusso, 16257.
Elionurus argenteus, 13881.
Elymus canadensis, 15955, 16374.
chubutensis, 14844.
condensatus, 13450.
triticoides, 13451.
sabulosus, 14845.
virginicus submuticus, 13452, 16375, 16376.
Emilia sonchifolia, 12981.
Emmer. See *Triticum dicoccum.*
Enterolobium cyclocarpum, 11592.
Eragrostis sp., 13867, 13868, 13875, 13876, 13885, 13896, 13897, 13900, 13904, 13906, 15338, 15342, 15358, 15359.
abyssinica, 11117, 11118, 12378, 12385, 12386, 14470.
brownii, 14897.
chloromelas, 13871.
lappula divaricula, 13884.
leptostachya, 14898.
major megastachya, 13921
pilosa, 12799, 14899.
plana, 13883.
Eremophila bowmani, 10501.
brownii, 10496.

Eremophila latifolia, 10497.
maculata, 10498.
mitchelli, 10499.
oppositifolia, 10500.
Eriobotrya japonica, 11631, 12832, 15809.
Eriodendron anfractuosum, 14813.
Eriostemon difformis, 10502.
Erodium chelidonifolium, 16216.
daucoides, 12618.
glandulosum, 16219.
gruinum, 16258, 16284.
hymenodes, 16215.
macradenum, 16220.
macrophyllum, 16222.
manescavi, 16221.
pelargonifolium, 16217.
stephanianum, 16259.
Ervum lens, 10236, 10237, 10752, 11080, 11105, 14462.
Erythrina coralloides, 13282.
monosperma, 14426.
Eschscholtzia californica, 12873.
Eucalyptus behriana, 10503.
botryoides, 11747.
coccifera, 10505.
corymbosa, 16786.
corynocalyx, 11736.
diversicolor, 10504.
goniocalyx, 16227.
incrassata, 10506.
longifolia, 11748.
tereticornis, 10507.
virgata, 10508.
Euchlena mexicana, 11172, 11480.
Eucommia ulmoides, 12136.
Eupatorium portoricense, 14999.
Euphorbia sp., 13140.
canariensis, 10693.
regis-jubae, 10694.
Eutelea arborescens, 11746.
Eutrema hederaefolia, 10579.
wasabi, 12451.
Fagopyrum esculentum, 10569, 11173.
tataricum, 14969.
Feijoa sp., 15818 to 15820.
sellowiana, 12850.
Fenugreek. See *Trigonella foenum-graecum.*
Ferula linkii, 10695.
Festuca arundinacea, 16377.
elatior, 11174, 16378.
gigantea, 15826.
heterophylla, 11175.
hyb., 16379.
ovina, 11176.
ingrata, 16244.
pabularis, 10976.
pratensis, 11177, 11482, 13453, 16380.
reflexa, 16381.
rubra, 11178.
Ficus sp., 12780, 13138, 14438.
glomerata, 12111.
rubiginosa, 15693.
Fig. See *Ficus* spp.
Filbert, Crimean, 10343, 10344.
See also *Corylus avellana.*
Flax, Russian, 9897 to 10167, 10315 to 10317, 10379 to 10381, 12744.
See also *Linum usitatissimum.*
Foeniculum dulce, 12700, 16309.
Footah, 13140.
Fragaria sp., 10751.
Francoa ramosa hybrida, 13718.
Fraxinus sp., 11635.
Freesia sp., 14788, 14799.
refracta alba, 14985.
Freycinetia arborea, 12104.
Fukuji, 16787.
Furcraea foetida, 10967.
Furze. See *Ulex europaeus.*
Gaillardia sp., 11770, 13605.
perennis, 13666.
Galilea juncea, 10696, 10737.
Gamboge. See *Garcinia morella.*
Garbanzo. See *Cicer arietinum.*
Garcinia cochinchinensis, 12021, 16477.
cornea, 11721.
cowa, 11785, 11787.
dioica, 11027.
dulcis, 11028, 11029.
ferrea, 16478.
fusca, 11030.
hanburyi, 16479.
indica, 11501, 16480.
livingstonei, 11483, 12811, 12960.
loureiri, 11031.
mangostana, 11725, 11732, 11786, 12022, 13135, 13572, 13800, 13987, 16131.
morella, 10522, 11478, 11790, 12693.
spicata, 11789, 16787.
xanthochymus, 11032, 11784, 11788, 12019, 13349.
Genista canariensis, 10697.
monosperma, 10698.
Gerardia tenuifolia hyb., 13667.
Gerbera jamesoni, 14432.
Ginseng. See *Panax ginseng.*
Gladiolus sp., 14073 to 14087, 14128 to 14132, 14317 to 14334, 14409, 14411.
alatus, 15594.
childsii, 14006 to 14034, 14268 to 14285.
cruentus, 14000.
dracocephalus, 14002, 14102 to 14109.
gandavensis, 12368, 14035 to 14061, 14156 to 14204, 14260 to 14265, 14371 to 14407.
hyb., 12682, 14079.
kelwayi, 14335 to 14370, 14408, 14410, 14412.
leichtlini, 14005.
lemoinei, 14062 to 14072, 14088 to 14101, 14133 to 14142, 14205 to 14236, 14266, 14267, 14286 to 14316.
nanceianus, 14110 to 14127, 14143 to 14155, 14237 to 14259.
psittacinus, 14003.

Gladiolus purpureo-auratus, 14001.
  saundersii, 14004.
  segetum, 10699.
Glaucium flavum, 13668.
Gleditschia sp., 10251.
Glycine hispida, 11179, 11180, 12399, 12400, 13502, 13503, 14952 to 14954, 16789, 16790, 16796.
Glycyrrhiza glabra, 13574.
Gonospermum fruticosum, 10700.
  revolutum, 10701, 10738.
Gooseberry. See *Ribes grossularia.*
Gorse. See *Ulex europaeus.*
Gossypium sp., 11045 to 11048, 11187 to 11190, 11502, 11775, 11776, 12306, 12938, 13079, 13238, 13583 to 13585, 14469, 14801, 14870, 14885 to 14887, 14945, 14946.
  arboreum, 10403, 10404.
  barbadense, 11181 to 11186, 11343.
  herbaceum, 11263.
  hirsutum, 13094 to 13101.
  tomentosum, 10964.
Gourd, Japanese, 10309, 10310.
  See also *Cucurbita* spp. and *Lagenaria* spp.
Grape (Algeria), 13133.
  (Central Asia), 10331 to 10334, 10598 to 10609.
  Crimean, 10340 to 10342.
  (France), 11372 to 11477, 12940 to 12957.
  See also *Vitis vinifera.*
Grass, Australian bluegrass. See *Andropogon sericeus.*
  Bermuda. See *Capriola dactylon.*
  brome. See *Bromus* spp.
  canary. See *Phalaris canariensis.*
  cane. See *Stipa tuckeri.*
  esparto. See *Stipa tenacissima.*
  guinea. See *Panicum maximum.*
  Johnson. See *Andropogon halepensis.*
  Hungarian. See *Setaria italica.*
  Kentucky bluegrass. See *Poa pratensis.*
  love. See *Eragrostis* spp.
  meadow fescue. See *Festuca pratensis.*
    rice. See *Microlaena stipoides.*
  Mitchell. See *Astrebla triticoides.*
  orchard. See *Dactylis glomerata.*
  pigeon. See *Chaetochloa glauca.*
  red fescue. See *Festuca rubra.*
  redtop. See *Agrostis alba.*
  rescue. See *Bromus unioloides.*
  rice. See *Ehrharta* sp.
  rye. See *Lolium* spp.
  sheep's fescue. See *Festuca ovina.*
  slender wheat. See *Agropyron tenerum.*
  summer. See *Panicum sanguinale.*
Grass, sweet vernal. See *Anthoxanthum odoratum.*
  tall fescue or meadow fescue. See *Festuca elatior.*
  velvet. See *Holcus lanatus.*
  wallaby. See *Danthonia semiannularis.*
  wild, 10227 to 10231.
Grevillea linearis, 10515.
  robusta, 11749.
Ground cherry. See *Physalis* spp.
Guava. See *Psidium guajava.*
Guayabillo. See *Psidium* spp.
Guerrero. See *Eupatorium portoricense.*
Guilleminea illecebroides, 11594, 11685.
Guizotia oleifera, 11093, 11107, 12389.
Gum tree. See *Eucalyptus* spp.
Hedysarum coronarium, 10325, 13989, 14991.
Helenium grandicephalum, 13697, 13698.
Helianthus sp., 11660, 11773.
  annuus, 10223 to 10225, 11191.
  multiflora, 12963.
Helichrysum bracteatum, 12986.
Hemp, Chinese, 10979.
  Russian, 10241, 10242.
  Swedish, 10281.
  See also *Cannabis sativa.*
Hesperaloë funifera, 13805.
Heteropogon contortus, 13873.
Hevea sp., 15885.
Hibiscus sp., 14439.
  sabdariffa, 16785.
Hicoria sp., 11254, 11256.
  hyb., 11628.
Hippeastrum sp., 13807.
Holcus lanatus, 12405, 13377, 16247.
Holly. See *Ilex crenata.*
Hollyhock. See *Althaea rosea.*
Homalomena wallisi, 15762, 16504.
Homeria discolor, 15680.
Honey locust. See *Gleditschia* sp.
Hop. See *Humulus lupulus.*
Hordeum sp., 11040 to 11044, 11116, 12124, 12375, 12376, 13578, 13969, 15821, 16329.
  bulbosum, 13562.
  distichum, 10362, 10363, 12023, 12121.
    erectum, 10586, 12119, 12129.
    nutans, 10402, 10583 to 10585, 11622, 12116 to 12118, 12125 to 12128, 12993, 13346, 15867.
  hexastichum, 10360, 10361, 12122.
  tetrastichum, 10674, 10754, 11623, 11716, 11717, 12120, 12709.
  vulgare, 10219 to 10222, 10270, 10275, 10276, 10985, 11192, 11193, 11264, 11265, 11620, 11621, 11658, 11678, 11780, 12123, 13854, 14964, 14965, 15799, 15829, 15830, 15866.

Horse-radish. See *Cochlearia armoracia.*
  Japanese. See *Eutrema wasabi.*
  Malin, 10462, 10576.
Horea heterophylla, 10509.
Humulus lupulus, 11683, 12805 to 12807.
Husk tomato. See *Physalis* spp.
Hyacinthus sp., 15430 to 15434, 15457, 15458, 15896 to 15904.
  orientalis, 12233, 12244 to 12257, 14790, 15806.
Hydrangea scandens, 12961.
Hydrastis canadensis, 13864.
Hymenocallis sp., 16142, 16147.
  littoralis, 10571.
Hymenosporum flavum, 11750.
Hyoscyamus niger, 12412, 12429.
Hypericum floribundum, 10702.
Hyphaene crinita, 11269.
Iberis amara, 13007.
  coronaria princeps, 13286.
Ibervillea sp., 16201, 16481.
  sonorae, 16200.
Ilex crenata, 10449.
Impatiens holstii, 13710.
Incarvillea delavaya, 13620, 13713.
Ipomoea sp., 12401, 12958.
  batatas, 14480, 16175 to 16188.
  hederacea, 13080 to 13083.
  pes-caprae, 11723.
Iris sp., 12370, 13227 to 13230, 15646 to 15654.
  ensata pabularia, 16334.
  gracilipes, 13231.
  hispanica, 15739 to 15743.
  kaempferi, 13159 to 13226.
  laevigata, 13233 to 13235.
  sibirica, 13232.
Ischnosiphon hirsuta, 16501.
Isolepis canariensis, 10733.
Jacaranda ovalifolia, 11642.
Juglans sp., 14997.
  cinerea, 11257.
  hyb., 10587, 11252.
  nigra, 11253.
  regia, 10339, 12114, 13573.
Juncus effusus, 12804, 13264, 13621, 14482, 16490.
    conglomeratus, 14778, 16491 to 16494.
  setchuensis, 13622.
Kafir corn. See *Andropogon sorghum.*
Kapoelasan. See *Nephelium mutabile.*
Karoobosch. See *Pentzia virgata.*
Kennedya rubicunda, 12800.
Kniphofia sp., 13632.
  hyb., 13631.
Kochia scoparia, 12990, 13077.
Kosam. See *Brucea sumatrana.*
Kosteletzkya pentacarpa, 10614.
Kulthi. See *Dolichos uniflorus.*
Kunzea pomifera, 15882.
Lactuca sativa, 10996, 10998, 10999.
Lagenaria vulgaris, 16332.
Landolphia sp., 11654.
Lansium domesticum, 12238, 13728, 13986.
  sumatrana, 11484.
Lapageria rosea, 14948.
Lappago racemosa, 16285.
Larkspur. See *Delphinium* spp.
Lathyrus sp., 14966.
  azureus, 11195, 16382.
  cicer, 13379.
  coccineus, 11196, 16383.
  ochrus, 16384.
  odoratus, 12359, 13306 to 13312.
  sativus, 10375, 11197 to 11199, 13378, 16385 to 16387.
  silurus, 16137.
  stipularis, 11194.
  sylvestris, 10255, 12361.
  tingitanus, 11200, 16388, 16389.
Lavandula abrotanoides, 10703.
  vera, 12413, 12430.
Leaf beet. See *Beta cicla.*
Leitchee, or litchi. See *Nephelium litchi.*
Lemon. See *Citrus limonum.*
Lemoncito, 14433.
Lens esculenta. See *Ervum lens.*
Lentil, Russian, 10236, 10237.
  See also *Ervum lens.*
Lepidium sativum, 11096.
Leptosyne stillmanni, 13669.
Lespedeza japonica, 13811.
  striata, 11201, 11479, 16474, 16475.
Lettuce. See *Lactuca sativa.*
Leucophae candidissima, 10704, 10739.
Liatris sp., 11772.
  scariosa, 11718, 11719.
Licorice. See *Glycyrrhiza glabra.*
Lilium sp., 11008, 11565 to 11589, 12565, 15933.
  alexandrae, 12143.
  auratum, 12144.
  batmanniae, 11565, 12145.
  brownii, 11580, 12146.
  candidum, 15944.
  columbianum, 15891.
  concolor, 11566 to 11569, 12148.
  cordifolium, 11570, 12147.
  dahuricum, 11576.
  elegans, 11571 to 11575.
  giganteum, 12364.
  hansoni, 11577, 12149.
  humboldtii, 15890.
  hyb., 13106, 15893, 15894.
  japonicum, 11578, 11580, 12146.
  krameri, 12150.
  leichtlinii, 11581, 12151.
  longiflorum, 11582, 12152.
    eximeum, 11728 to 11730, 14481, 15478, 15746.
    eximium giganteum, 11583, 11590, 11591, 15479, 15584, 15942.
    multiflorum, 11794, 15943.
  medeoloides, 11584, 12153.
  mexicanum, 11686.
  neilgherrense, 10963, 11649, 12896.
  pardalinum, 12680, 15892, 15895.
    × *humboldtii*, 15894.

Lilium pardalinum × *parvum*, 15893.
philippinense, 10966, 12235, 14812.
rubellum, 11579.
speciosum, 11585 to 11588.
album, 12154.
tigrinum, 12155.
Lily (Mexico), 10571.
See also *Lilium* spp.
Lime, Finger. See *Citrus australasica.*
(India), 10365.
See also *Citrus limetta.*
Linum austriacum, 10147.
usitatissimum, 9897 to 10167, 10315 to 10317, 10378 to 10381, 11079, 11113, 11267, 12391, 12774, 16321.
Lippia repens, 11682, 12819.
Lobelia sp., 13606, 13607.
inflata, 12904.
tenuior, 13711.
Lolium bonaerensis, 13797, 16390.
italicum, 11202, 12892, 13339.
perenne, 10588, 11203, 11481, 12893, 16391 to 16394.
Longan. See *Nephelium longanum.*
Loquat. See *Eriobotrya japonica.*
Lotus americanus, 16395, 16396.
canariensis floribunda, 10705.
corniculatus, 10253, 11204, 13750, 16397.
tetragonolobus, 10398, 16398.
Lupine. See *Lupinus* spp.
Lupinus sp., 11637.
affinis, 11205.
angustifolius, 11206.
luteus, 11207.
Lycopersicum esculentum, 12705, 12706, 12725, 12726, 13001.
Maba sandwicensis, 14424.
Macadamia ternifolia, 11797, 15697.
Magnolia pumila, 10968.
stellata rosea, 13802.
Mahogany. See *Swietenia mahagoni.*
Malpe. See *Bidens heterophylla.*
Mammea americana, 11648.
Mammee apple. See *Mammea americana.*
Manfreda sp., 16159.
Mangifera cambodiana, 11645.
indica, 10636 to 10669, 10960, 11369, 11625, 11766, 11779, 12240, 12241, 12305, 12930, 12931, 13338, 13348, 14448, 15424.
mekongensis, 11646.
Mango (Africa), 11779.
(Florida), 12138, 12240, 12241, 12305.
(Hawaii), 11766, 12930, 12931.
(India), 10636 to 10669, 11369, 13338, 13348, 15424.
(Mexico), 14448.
(Tahiti), 10960, 11625.
See also *Magnifera indica.*
Mango ginger. See *Curcuma amada.*
Mangosteen. See *Garcinia mangostana.*
Manihot sp., 11698 to 11713.
Manila hemp. See *Musa textilis.*
Maple, broad-leaved. See *Acer macrophyllum.*
Maranta sp., 16764.
amabilis, 16503.
lineata rosea, 15677.
splendida, 16765.
wallisi, 16502.
Mariposa lily. See *Calochortus* sp.
Maritzgula. See *Carissa arduina.*
Martingula. See *Carissa arduina.*
Matondo, 13132.
Matricaria eximia, 13617.
Matundulaku, 12810, 12959.
Meconopsis integrifolia, 13340.
Medicago sp., 13809.
cancellata, 13648.
carstiensis, 14853.
ciliaris, 16260.
denticulata, 11208, 13552, 16771.
echinus, 16261.
elegans, 16262.
gerardi, 16286.
lupulina, 13742, 13751, 16138.
maculata, 16213.
media, 13488, 16399, 16400.
minima, 16264.
orbicularis, 10725, 16265.
radiata, 16266.
rigidula, 16286.
sativa, 10232 to 10235, 11209 to 11211, 11275, 11651, 11652, 12231, 12398, 12409, 12549, 12671, 12694 to 12696, 12702, 12747, 12748, 12772, 12784, 12801, 12803, 12816, 12820, 12846, 12847, 12991, 12992, 13237, 13259, 13291, 13358, 13435 to 13440, 13478 to 13487, 13489, 13519 to 13521, 13541 to 13547, 13561, 13564, 13738, 13739, 13743 to 13745, 13653 to 13755, 13757 to 13759, 13767, 13769, 13778, 13857, 13858, 13999, 14496, 14497, 14883, 14886, 14962, 16136, 16209, 16317, 16401 to 16403, 16508.
getula, 12803.
× *falcata*, 16263.
scutellata, 16267.
terebellum, 16287.
turbinata, 16288.
Melaleuca pustulata, 10510.
Melica californica, 16407.
Melilotus alba, 11212, 16135, 16289, 16489.
altissima, 16268.
elegans, 14854.
indicus, 16404.
italica, 16269.
macrostachys, 16405.
speciosa, 13559.
sulcata, 13558, 14855, 16406.

- *Melilotus tommasini*, 14856.
- Melon. See *Cucumis* spp.
- *Mesembryanthemum* sp., 12574 to 12576.
  - *crystallinum*, 10706, 10740.
  - *geminatum*, 13102.
- *Mesua ferrea*, 11033.
- *Mezoneuron kauaiensis*, 14425.
- *Microlaena stipoides*, 15951.
- *Milla biflora*, 16151.
- Millet, German. See *Chaetochloa italica*.
  - Italian. See *Chaetochloa italica*.
  - broom-corn. See *Panicum miliaceum*.
  - pearl. See *Pennisetum typhoideum*.
  - See also *Chaetochloa italica*.
- Milo maize. See *Andropogon sorghum*.
- *Miscanthus condensatus*, 10524, 12156.
- *Monarda fistulosa*, 12447.
  - *punctata*, 12448.
- *Monstera deliciosa*, 15673.
- *Moraea iridioides*, 13732.
- Morning-glory (Japan), 10623, 13080 to 13083.
  - See also *Convolvulus* spp.
- *Morus alba*, 12859.
- *Mucuna utilis*, 11213, 11503.
- Mulberry. See *Morus* spp.
- Mung bean. See *Phaseolus max* and *Phaseolus radiatus*.
- *Musa* sp., 11647, 15876 to 15879.
  - *ensete*, 14457.
  - *sapientum*, 10965, 13568.
  - *textilis*, 10405, 12708, 16214.
- Mushroom. See *Agaricus* spp.
- Muskmelon. See *Cucumis melo*.
- Mustard, Russian, 10245 to 10247.
  - See also *Brassica* spp.
- *Myoporum deserti* 10511.
  - *sandwicensis*, 14431.
- *Myosotis* sp., 13610, 13715.
- Myrobalan. See *Terminalia* sp.
- *Myrsine lassertiana*, 14428.
- *Narcissus* sp., 12263 to 12265, 12280 to 12302, 15667, 15703, 15705 to 15708, 15744, 15769, 15772, 15844, 15847.
  - *barrii conspicuus*, 15845.
  - *bicolor*, 15438, 15449, 15455, 15589, 15590, 15593, 15666, 15701.
    - *horsfieldii*, 15586, 15658. 15699.
  - *biflorus*, 15446.
  - *incomparabilis*, 15447, 15454, 15591, 15662, 15702.
  - *pachybolbus*, 13305.
  - *poeticus*, 15440, 15450, 15452.
    - *alba*, 14491.
    - *ornatus*, 15451, 15663, 15770.
  - *pseudo-narcissus*, 15423, 15435 to 15437, 15448, 15453, 15456, 15585, 15587, 15588, 15592, 15659 to 15661, 15664, 15700, 15704, 15709, 15767, 15768, 15771, 15773, 15846, 15848.
  - *tazetta alba*, 15439, 15459, 15657, 15698, 15774.
- Nectarine. See *Amygdalus persica*.
- *Nelumbium speciosum*, 12157 to 12176.
- *Nephelium lappaceum*, 13258, 13571, 13798.
  - *litchi*, 10670 to 10673, 11342, 14888, 16237 to 16243.
  - *mutabile*, 13799, 13861, 13988, 14815.
- *Nerine* sp., 14789.
- *Nicotiana sanderae*, 12139, 12358.
  - *tabacum*, 10451 to 10453, 11001, 11035 to 11038, 11497, 11498, 11999, 12000, 12105 to 12107, 12683, 12920, 14420, 14421, 14871 to 14878, 14975 to 14979, 16788.
- *Nuphar polysepalum*, 11783.
- Nut, Australian. See *Macadamia ternifolia*.
- Oak, cork, 10264.
  - See also *Quercus* spp.
- Oat, (Algeria), 10269.
  - (England), 10354 to 10359.
  - (Finland), 10271.
  - (Germany), 14802.
  - (New Zealand), 12877 to 12882.
  - (Norway), 13576, 13577.
  - (Russia), 10183 to 10193, 10321, 10624.
  - (Sweden), 10278, 10279.
  - Swedish Select, 10330, 10455.
  - (Transvaal), 13968.
  - See also *Avena sativa*.
- *Oenothera ovata*, 15883.
  - *rosea*, 10707, 10741.
- *Olea europaea*, 12569 to 12573, 12672 to 12677, 12684, 12685, 12753, 12754, 12910, 12921, 13257, 13567.
- *Olearia pimeloides*, 10512.
- Olive. See *Olea europaea*.
- *Onagraceae*, 16199.
- Onion. See *Allium cepa*.
- *Onobrychis onobrychis*, 13794, 13991, 16246.
- *Opuntia* sp., 14476, 14787, 14822 to 14839, 14923 to 14944, 14949 to 14951, 14980 to 14983, 15839 to 15843.
  - *ficus-indica*, 12837 to 12842, 13350, 14777, 14806 to 14810, 14816 to 14821, 15850.
  - *gymnocarpa*, 12112, 12402, 12403, 15777.
  - *tomentosa*, 12836.
- Orange. See *Citrus aurantium*.
- *Orania philippinensis*, 14472, 14814.
- *Orchidaceae*, 11346, 13273.
- *Origanum vulgare*, 12422, 12432.
- *Ornithopus sativus*, 12407, 13990.
- *Oryza glutinosa*, 13047 to 13054, 13069 to 13076, 16189.
  - *sativa*, 12130, 12453 to 12457, 12679, 12711 to 12715, 12759 to 12767, 12808, 12852, 12865 to 12871, 12874 to 12876, 13035 to 13076, 14779 to 14785, 14963, 14967, 15480 to 15583, 15759 to 15761, 15778, 15881, 16328.
  - *utilissima*, 13035 to 13046, 13055 to 13068.

Pachyrhizus sp., 12369.
Paeonia sp., 12028 to 12103, 16541 to 16659.
  anomala, 16660.
  moutan, 16663 to 16762.
  tenuifolia, 16661, 16662.
Panax elegans, 11751.
  gaudichaudii, 14423.
  ginseng, 10326, 12443 to 12446.
Pancratium sp., 11002.
Pandanus luzonensis, 14473.
Panicum sp., 16408, 16409.
  colonum, 13894.
  crus-galli, 16410, 16411.
  decompositum, 11727.
  effusum, 14902.
  isachne, 13913.
  maximum, 11800, 12365, 12678, 13563, 14492, 14776.
  miliaceum, 10625, 11495, 12016 to 12018, 14955, 14956, 14968, 16314, 16412 to 16423.
  sanguinale, 14903.
  sulcatum, 13922.
  teneriffae, 13893.
Papaver sp., 10259, 11798.
  bracteatum, 13677.
  croceum, 13674, 13675.
  nudicaule, 13633, 13649 to 13652.
  orientale, 13634 to 13636, 13653 to 13656, 13658, 13676, 13724.
  rhoeas, 12785.
  somniferum, 12906, 12907, 12966 to 12970, 13107, 15822 to 15824.
    ×*P. bracteatum*, 11798.
Papaw. See *Carica papaya.*
Papyrus. See *Cyperus papyrus.*
Pardanthus chinensis. See *Belamcanda punctata.*
Parietaria arborea, 10708, 10742.
Parkinsonia sp., 15808.
Parota. See *Enterolobium cyclocarpum.*
Paspalum sp., 15362.
  brevifolium, 14904.
  digitatum, 16230.
Passiflora acerifolia, 11124.
  alata, 11126.
  coerulea, 11120.
  edulis, 11121, 12899.
  ligularis, 11125.
  manicata, 11123.
  pfordii, 11122.
Passion flower. See *Passiflora* spp.
Pea, field. See *Pisum arvense.*
  (Finland), 10274.
  flat. See *Lathyrus sylvestris.*
  (New Zealand), 12887 to 12889.
  Russian, 10238 to 10240.
  sweet. See *Lathyrus odoratus.*
  Tangier scarlet. See *Lathyrus tingitanus.*
  Tibetan, 15750.
  See also *Pisum* spp.
Peach (Arabia), 10457.
  (Central Asia), 10335 to 10337.
  (China), 15753, 15754, 15935.
  See also *Amygdalus persica.*
Peanut (Australia), 16233 to 16236.
  (Brazil), 11532.
  (China), 14961, 14962.
  (France), 15782 to 15787, 16161.
  (Italy), 16162 to 16164.
  (Japan), 10622.
  (Natal), 16472.
  See also *Arachis hypogaea.*
Pear. See *Pyrus* sp.
Pecan. See *Hicoria pecan.*
Pennisetum macrophyllum atrosanguineum, 13646.
  typhoideum, 11214, 12851, 16424.
Pentstemon sp., 13696.
  hyb., 13678, 13679.
Pentzia virgata, 10635, 11740.
Pepino. See *Solanum muricatum.*
Pepper, chili, 11639, 14484.
  Japanese. See *Xanthoxylum piperitum.*
  paprika, 10392, 10755, 10756, 11741, 11742.
  red, 10393 to 10395.
  sweet, 10396, 14485.
  See also *Capsicum* spp.
Perilla ocymoides, 10632.
Periploca laevigata, 10709, 10743.
Persea carolinensis, 11765.
  gratissima, 10615 to 10620, 10978, 11724, 12933 to 12937, 13292, 13729 to 13731, 14435, 14463, 14889 to 14890, 15656, 16170.
  indica, 14498, 16133, 16169.
Persimmon, Japanese. See *Diospyros kaki.*
Petroselinum sativum, 12721.
Phalaris arundinacea, 13951, 16425.
  canariensis, 13300 to 13303, 13586, 13947 to 13950, 16426 to 16432.
Phaseolus sp., 13392, 13393, 16791.
  angularis, 10523, 13384 to 13391, 13405.
  caffer, 16290.
  calcaratus, 13380 to 13383.
  lunatus, 12730, 14974.
  max, 13400 to 13403, 16129.
  multiflorus, 16302.
  radiatus, 10284, 10329, 10407, 10527, 10610, 11098, 12775, 13394 to 13399, 14960, 15926, 16210, 16211, 16323, 16793.
  retusus, 13404.
  vulgaris, 10353, 11055 to 11057, 12736, 12743, 12817, 12818.
Philadelphus lemoinei, 16513.
Phleum alpinum, 10548.
  medium, 10547.
  michelii, 10549, 14846.
  pratense, 10282, 10456, 10458 to 10461, 10545, 10546, 10550, 10578, 10589, 10621, 10726, 11000, 11215, 11494, 12234, 12894, 13580, 15669, 16433 to 16435.
Phlox decussata, 13680, 13681, 16514 to 16540.

Phlox drummondii, 12965.
Phoenix dactylifera, 10757 to 10958, 11003, 11128, 11277 to 11341, 11485 to 11489, 11801 to 11996, 15000 to 15314.
Phyllostachys henonis, 12177.
mitis, 12178.
nigra, 12179.
quilioi, 12180.
Physalis sp., 12395, 12396, 15745, 15931.
edulis, 14908.
Picrasma ailanthoides, 12861.
Pimbe, 12811, 12960.
Pimpinella anisum, 12388, 12701.
Pineapple. See *Ananas sativus.*
Pinguicula sp., 12995, 14998.
caudata, 12996.
Pinus canariensis, 10710.
parviflora, 15928.
Piper nigrum, 15681.
Pistache. See *Pistacia vera.*
Pistacia sp., 13154.
atlantica, 10267, 10288, 10328.
chinensis, 10285.
mutica, 10265, 10266, 10287, 10377.
terebinthus, 10268, 10286, 10322, 12232.
vera, 10323, 10376, 11778, 12243, 12746, 12782, 12783, 12815, 12835, 12848, 12922 to 12924, 13569.
Pisum sp., 10986, 11097, 11111, 11112, 15750, 16326.
arvense, 11216, 13992, 16130, 16436, 16437.
elatius, 16301.
jomardi, 16291.
sativum, 10238 to 10240, 10274, 10987, 12392, 12698, 12722, 12723, 12731, 12887 to 12889, 13579.
Pittosporum buchanani, 11752.
macrophyllum, 11644.
undulatum, 11753.
Plantago fastigiata, 16438, 16439.
Plocama pendula, 10711.
Plum, Russian, 10262, 10263.
Turkish, 10526, 13157.
wild African, 12751, 13139, 13141.
See also *Prunus* spp.
Poa attica, 14847.
mulalensis, 10977.
pratensis, 11217, 11737, 12550, 16228.
triflora, 16440.
Podocarpus elata, 15694.
Podolepis acuminata, 10513.
Polianthes elongata, 11260.
longiflora, 11533.
tuberosa, 14811.
Polygonum baldschuanicum, 13599.
monspeliensis, 13664.
Polypteris texana, 16160.
Pomegranate. See *Punica granatum.*
Pomelo. See *Citrus decumana.*
Popcorn, (Brazil), 13260 to 13262.
(Chile), 14909 to 14921.
(Dutch East Indies), 14992.
(India), 13354.
See also *Zea mays.*
Poppy, California. See *Eschscholtzia californica.*
Tibetan. See *Meconopsis integrifolia.*
See also *Papaver* spp.
Portulacaria afra, 12020.
Potato, American, 10570, 14800.
aquatic, or "Mercedes." See *Solanum commersoni.*
(Ecuador), 14893 to 14895, 14973, 16248 to 16253.
(England), 12608 to 12613, 12643 to 12668.
(France), 12602 to 12607.
(Germany), 12578 to 12596.
(Holland), 12597 to 12601.
(Scotland), 12614 to 12649, 13027 to 13034, 14490.
sweet. See *Ipomoea batatas.*
wild, 10473.
See also *Solanum tuberosum.*
Poterium sanguisorba, 12577.
Primula sp., 13613.
Proso. See *Panicum miliaceum.*
Prostanthera striatifolia, 10514.
Prunus sp., 10260, 11020, 11636, 14434, 15810.
armeniaca, 11633.
cerasus, 10580 to 10582, 11034.
divaricata, 10262, 10263.
domestica, 10526, 13157.
paniculata, 12181 to 12230.
pseudo-cerasus. See *Prunus paniculata.*
sibirica, 14487.
virginiana, 11499, 11500.
Psidium sp., 10464.
guajava, 11726, 13806.
molle 11004, 11005, 12716, 12821.
Psoralea bituminosa, 10712.
Pumpkin. See *Cucurbita pepo.*
Punica granatum, 10368 to 10370, 12566 to 12568, 12925, 12998, 12999, 13298.
Pyrethrum cinerarifolium, 12416, 12435.
roseum, 12415, 12434.
Pyrus sp., 15375.
malus, 10261, 10345 to 10348, 10525, 13087, 13156.
Quercus cornea, 10633.
cuspidata, 13997.
suber, 10264.
Quince. See *Cydonia* sp.
Radish. See *Raphanus* spp.
Rambutan. See *Nephelium lappaceum.*
Ranunculus canariensis, 10713.
Rape, Italian, 13733.
Russian, 10243, 10244.
See also *Brassica napus.*
Raphanus sp., 15321 to 15332, 15814, 15815.
sativus, 10397, 10399, 10990, 12707, 12724, 12919.
Raspberry. See *Rubus* spp.
Rauwolfia sandwicensis, 14422.
Red bay. See *Persea carolinensis.*
Rhamnus alaternus calabrica, 12858.
crenulata, 10714.
purshiana, 12734.
Rheum officinale, 13089.

Rheum palmatum tanghuiticum, 13093.
Rhodocystus berthelotianus, 10715, 10744.
Rhubarb. See *Rheum* spp.
Rhus sp., 13155.
Ribes grossularia, 10250.
Rice (Brazil), 12522.
  (British Guiana), 12489 to 12512.
  (Ceylon), 12464 to 12478, 12808.
  (China), 12874 to 12876, 16189, 16328.
  (Dutch East Indies), 15778.
  (Egypt), 12513 to 12515.
  (Formosa), 13035 to 13076.
  (France), 12453 to 12463.
  (German East Africa), 12523, 12524, 15480 to 15583.
  (Greece), 12521.
  (India), 12130, 12865 to 12871, 14779 to 14785, 14967.
  (Italy), 12519, 12520.
  (Japan), 12679, 12711 to 12715, 12761 to 12765, 14963, 15759 to 15761.
  (Java), 12525 to 12547, 12759, 12760.
  (Korea), 12766, 12767.
  (Siam), 12516 to 12518.
  (Singapore), 12479 to 12488.
  wild. See *Zizania aquatica*.
  See also *Oryza sativa*.
Ricinus sp., 11068 to 11073, 11638.
  zanzibariensis, 12856.
Rosa sp., 11517 to 11531, 11536 to 11538, 13116 to 13120, 13243 to 13255, 13320 to 13337, 15425, 15426.
  humilis, 11519.
  rugosa, 12915.
    hyb., 13108 to 13115, 13121 to 13129.
Roselle. See *Hibiscus sabdariffa*.
Rosmarinus officinalis, 12418, 12438.
Rubber. See *Castilla* spp. and *Landolphia* sp.
Rubia fruticosa, 10716, 10745.
Rubus sp., 15376.
  australis, 11505.
  biflorus, 11506.
  deliciosus, 11512.
  hyb., 11516.
  leucodermis, 11513.
  nigrobaccus, 11510, 11515.
  occidentalis, 11514.
  odoratus, 11507.
  phoenicolasius, 11509.
  rosaefolius, 11508.
  spectabilis, 11511, 15427.
  villosus, 11515.
Rudbeckia fulgida variabilis, 13663.
    speciosa bicolor, 13704.
Rumex lunaria, 10717.
Rush. See *Juncus* spp.
Rye, Abruzzes, 10366.
  (Finland), 10273.
  German, 11735.
  Russian, 10168 to 10182, 10320.
  Swedish, 10280.
  Winter Ivanof, 10367.
  See also *Secale cereale*.
Saccharum officinarum, 12739 to 12742, 12786 to 12789.
Safflower. See *Carthamus tinctorius*.
Sage. See *Salvia officinalis*.
Sainfoin. See *Onobrychis onobrychis*.
Salix sp., 12914, 12916.
  alba argentea, 12347.
    britzensis, 12318.
    vitellina, 12324.
      aurantiaca, 12334.
      flava, 12320.
      nova, 12356.
  ambigua, 12337.
  argentea auritea, 12315.
  babylonica, 12344.
  bataviae, 12317.
  bicolor laureana, 12332.
  blanda (*S. babylonica* × *fragilis*), 12331.
  caesia pendula zabeli, 12307.
  casiandra lancifolia, 12312.
  cinerea repens, 12345.
    tricolor, 12336.
  cordata vestita, 12355.
  daphnoides femina, 12321.
    mascula, 12330.
    pomerania femina, 12309.
  decipiens, 12333.
  erdingeri, 12325.
  fragilis ammaniana, 12346.
    basfordiana, 12313.
  hippophaifolia undulata, 12353.
  laurina, 12343.
  longifolia, 12342.
  mollissima, 12351.
  nigricans, 12350.
    ansoniana, 12326.
    cotinifolia, 12319.
    menthifolia, 12348.
    moabitica, 12316.
    prunifolia, 12308.
    viburnoides, 12357.
  pellita, 12340.
  petiolaris, 12322.
  purpurea lambertiana, 12335.
    scharfenbergensis, 12311.
    urabensis, 12327.
  repens argentea, 12341.
  rosmarinifolia, 12349.
  rubra forbyana, 12314.
  seringeana, 12323.
  smithiana acuminata (*S. dasyclados*), 12339.
  spaethi, 12354.
  triandra (*S. lappeana*), 12310.
  undulata, 12328.
  viminalis, 12329.
    superba, 12352.
  voronesh, 12338.
Salmon-berry. See *Rubus* spp.
Saltbush. See *Atriplex* spp.
Salvia argentea, 13686.
  carduacea, 13687.
  coccinea, 13688.
  officinalis, 12423.
Sansevieria cylindrica, 15675.
Sanvitalia procumbens, 12864.
Sapindus utilis, 13304.
Sapium sebiferum, 11795.

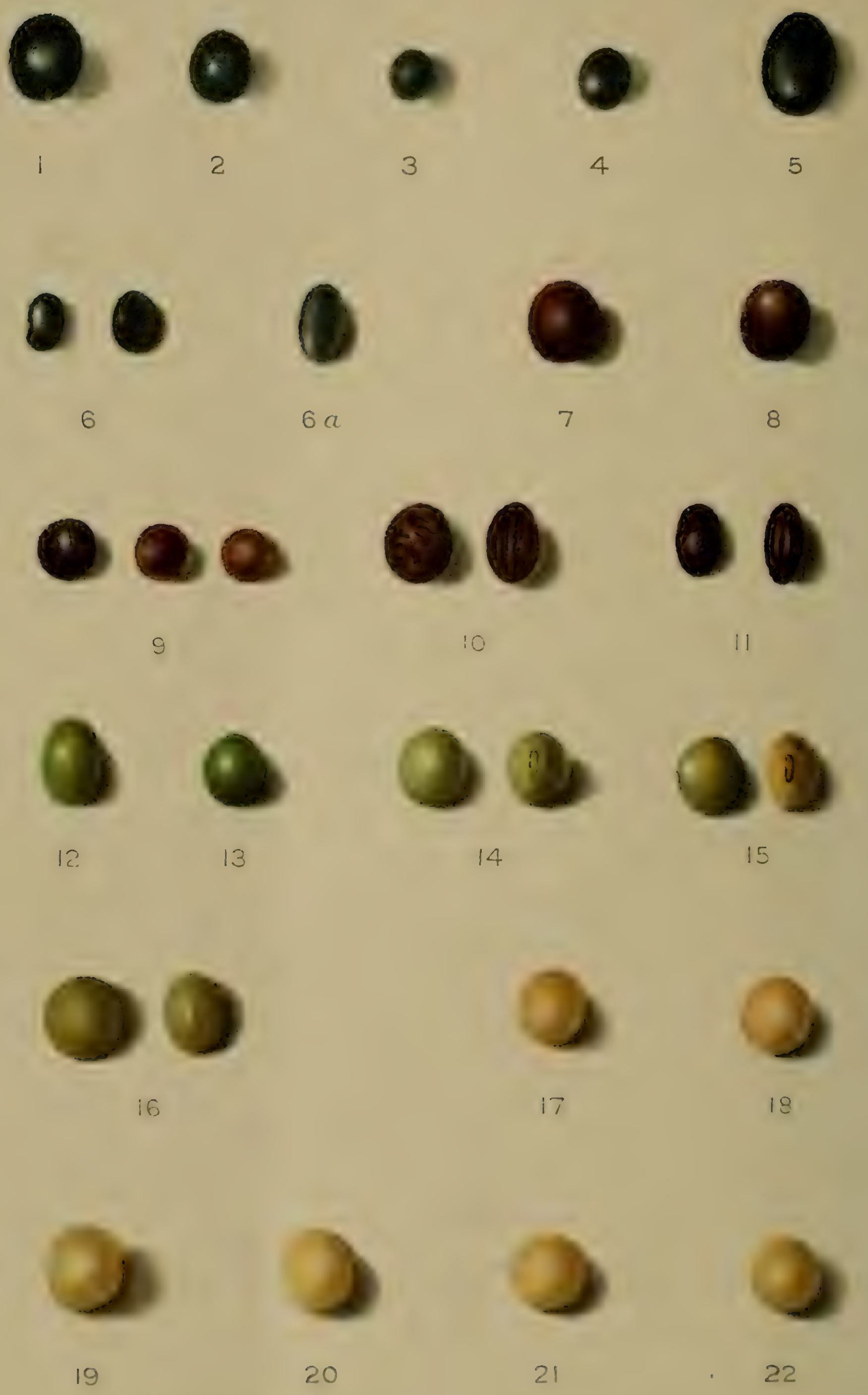
Sapodilla. See *Achras sapota.*
Sapote blanco. See *Cassimiroa edulis.*
Satureja hortensis, 12419, 12439, 12905.
Schoenocaulon sp., 14996.
  officinale, 14486, 15828.
Scirpus triqueter, 13265.
Scitamineae, 12551.
Sclerolaena bicornis, 10517.
Scotch broom. See *Citisus scoparius.*
Scurvy grass. See *Cochlearia officinalis.*
Secale cereale, 10168 to 10182, 10273, 10280, 10320, 10366, 10367, 11218, 11219, 11268, 11735, 11760, 12855, 15800, 15868, 15869.
Sechium edule, 10959, 12024, 12025, 12115, 12304, 12366, 12737, 12909, 13084.
Sempervivum tabulaeformae, 10718.
Senna. See *Cassia angustifolia.*
Sequoia gigantea, 11997.
Serradella. See *Ornithopus sativus.*
Sesame. See *Sesamum indicum.*
Sesamum indicum, 12387, 14958, 14959, 16311.
Sesbania macrocarpa, 11781.
  tripetii, 12857.
Setaria sp., 15341.
  aurea, 15344.
  italica. See *Chaetochloa italica.*
  sulcata, 15366.
Shasta daisy. See *Chrysanthemum leucanthemum* hyb.
Sicana odorifera, 11720.
Sideritis massoniana, 12860.
Silene armeria, 13689, 13690.
  orientalis, 13615.
  pendula, 13691 to 13693.
Smilax medica, 15674.
  sandwicensis, 10314.
Soapberry. See *Sapindus utilis.*
Solanum sp., 11272.
  commersoni, 10324, 12113, 13105, 14475.
  jamesii, 10473.
  muricatum, 14891.
  tuberosum, 10570, 12578 to 12668, 13027 to 13034, 14490, 14800, 14893 to 14895, 14973, 16284 to 16253.
Sorbus domestica, 10349 to 10351.
Sorghum (Africa), 10327, 11793.
  (Central Asia), 10612.
  (India), 14500 to 14775.
  See also *Andropogon sorghum.*
Sorghum halepense. See *Andropogon halepensis.*
  vulgare. See *Andropogon sorghum.*
Sow-itk. See *Carum gairdneri.*
Sparaxis bulbifera, 14986.
  purpurea, 14987.
Spartina sp., 16441.
  cynosuroides, 16442.
Spergula arvensis, 12406.
Spikenard. See *Aralia racemosa.*
Spinach, New Zealand. See *Tetragonia expansa.*
Spondias purpurea, 11006, 11007.
Sporobolus lindleyi, 10516.
Sprekelia, 16149.
Sprekelia formosissima, 12997.
Spurry. See *Spergula arvensis.*
Squash. See *Cucurbita* spp.
Stachys sieboldii, 10634.
Statice brassicaefolia, 10719.
  pectinata, 10720, 10746.
Sterculia acerifolia, 11754, 15695.
  diversifolia, 11755, 14900.
Stipa tenacissima, 13860, 16443.
  tuckeri, 14906.
Strawberry. See *Fragaria* sp.
Stuartia pentagyna, 13299.
  pseudo-camellia, 13998.
Sugar cane. See *Saccharum officinarum.*
Sulla. See *Hedysarum coronarium.*
Sumac. See *Rhus* sp.
Sunflower, Russian, 10223 to 10225.
  See also *Helianthus annuus.*
Swainsona maccullochiana, 15954, 16140.
Sweet fennel. See *Foeniculum dulce.*
Swietenia mahagoni, 10409.
Syncarpia laurifolia, 11756.
Synnotia bicolor, 14988.
Tacca pinnatifida, 10313, 15838.
Tacsonia exoniensis, 11127.
Tagasaste. See *Cytisus proliferus albus.*
Tagetes sp., 12978.
Talinum sp., 16158.
Tallow tree. See *Sapium sebiferum.*
Tamarind. See *Tamarindus indica.*
Tamarindus indica, 15880.
Tamus edulis, 10721, 10747.
Tangelo. See *Citrus* hyb.
Taro. See *Colocasia* sp.
Tecoma capensis, 16232.
Telopia speciosissima, 15696.
Teosinte. See *Euchlaena mexicana.*
Terebinth. See *Pistacia terebinthus.*
Terminalia sp., 12553 to 12556.
Tetragonia expansa, 12779.
Teucrium hyssopifolium, 10722, 10748.
Themeda ciliata. See *Anthistiria ciliata.*
Theobroma cacao, 11656, 15747 to 15749.
Thevetia sp., 11691.
  cuneifolia, 11626, 11627, 11799.
  ovata, 11659.
Thuja gigantea, 12237.
Thymus vulgaris, 12417, 12437.
Thysanolaena agrostis, 11739, 14922.
Tijocate. See *Crataegus* sp.
Timothy. See *Phleum pratense.*
Tobacco (Brazil), 11001, 11035 to 11038, 11498, 12105 to 12107, 14420, 14421, 14871, 14878, 14975 to 14979, 16788.
  Cuban, 10452, 10453.
  flowering, 12139, 12358.
  (Turkey), 11497.
  See also *Nicotiana tabacum.*
Tomato. See *Lycopersicum esculentum.*
Tree cotton. See *Gossypium arboreum.*
  tomato. See *Cyphomandra betacea.*
Trefoil, bird's-foot. See *Lotus corniculatus.*
  yellow. See *Medicago lupulina.*
Trichinium alopecuroideum, 10518.
  exaltatum, 10520.
  nobile, 10521.

Trichinium obovatum, 10519.
Tricholaena rosea, 13893.
Trifolium sp., 10254, 10566, 13810.
    alexandrinum, 10373, 10374, 11221, 11782, 12132, 13500, 13528.
    alpestre, 14857.
    badium, 14858.
    filiforme, 13532.
    fragiferum, 13533.
    hybridum, 10567, 11019, 11222, 13501, 13510, 13534, 13535, 13551, 13765, 13775.
    incarnatum, 11223, 13491 to 13494, 13497, 13537 to 13540, 13764, 14466, 14494, 14994, 15476, 15477.
    johnstoni, 10352.
    longipes, 13560.
    lupinaster, 10565.
    maritimum, 12927.
    montanum, 14859.
    ochroleucum, 14860.
    pannonicum, 13536, 16444.
    polystachyum, 12928.
    pratense, 10532 to 10534, 10563, 10564, 10577, 10626, 10627, 11018, 11224, 12891, 13490, 13495, 13496, 13498, 13499, 13506 to 13509, 13513, 13515 to 13517, 13522 to 13527, 13548, 13549, 13581, 13734 to 13737, 13740, 13741, 13746 to 13749, 13752, 13756, 13760, 13761, 13763, 13766, 13770 to 13772, 13774, 13776, 14493, 16445.
        perenne, 13772.
    procumbens, 12929.
    repens, 11225, 11276, 12890, 13511, 13512, 13518, 13529 to 13531, 13550, 13773, 13777, 13853, 14495.
        perenne, 13773.
    rubens, 14861.
Trigonella coerulea, 16270.
    corniculata, 16271.
    foenum-graecum, 10993, 11087, 11088, 16335, 16446.
Tristania laurina, 11757.
Triticum sp., 11049 to 11054, 11731, 12377.
    boeoticum, 16292.
        thaoudar, 16293.
    cristatum, 14848.
    dasyanthum, 14849.
    desertorum, 14850.
    dicoccum, 11094, 11650, 12379, 12853, 16294.
    durum, 10364, 10391, 10454, 11039, 11099, 11618, 11619, 11715, 13854 to 13856, 15788.
    giganteum, 16295.
    intermedium, 14851.
    (mixt), 10385 to 10389.
Triticum monococcum, 10474, 15853 to 15855, 16296.
        hornemanni, 16297.
    polonicum, 10611, 16298.
    rigidum, 16272, 16299.
    spelta, 15865.
    trichophorum, 16273.
    violaceum, 14852, 16347.
    vulgare, 10194 to 10218, 10272, 10277, 10318, 10319, 10382 to 10384, 10390, 10552, 10992, 11226 to 11229, 11266, 11603 to 11623, 11714, 12001 to 12015, 12134, 12883, 12884, 13973 to 13975, 14803, 14970, 15801, 15802, 15870 to 15874, 16327.
Tritonia fenestrata, 14989.
Trixago versicolor, 10749.
Tuberose. See *Polianthes* spp.
Tulipa sp., 12258 to 12262, 12266 to 12279, 14419, 15443 to 15445, 15710 to 15738, 15905 to 15925.
    armena, 15596.
    australis, 15597.
    aximensis, 15598.
    batalini, 15599.
    biebersteiniana, 15600.
    biflora, 15601.
    billietiana, 15602.
    clusiana, 15603.
    dasystemon, 15604.
    didieri, 15605.
        alba, 15606.
        lutescens, 15607.
    eichleri, 15608.
    fragrans, 15609.
    galatica, 15610.
    greigi, 15611.
        aurea, 15612.
    hageri, 15613.
    ingens, 15614.
    kaufmanniana, 15615.
        aurea, 15616.
        coccinea, 15617.
    kolpakowskyana, 15618.
        splendens, 15619.
    linifolia, 15620.
    lownei, 15621.
    maculata, 15622.
    marjolleti, 15623.
    mauriana, 15624.
    micheliana, 15625.
    montana, 15626.
    oculus solis, 15627.
    orphanidesi, 15628.
    ostrowskyana, 15629.
        crocea, 15630.
    patens, 15631.
    persica, 15632.
    planifolia, 15633.
    praecox, 15634.
    praestans, 15635, 15636.
    primulina, 15637.
    pulchella, 15638.
    saxatilis, 15639.
    sprengeri, 15640.
    stellata, 15641.
    strangulata, 15642.

Tulipa sylvestris, 15643.
  triphylla, 15644.
  tubergeniana, 15595.
  wilsoniana, 15645.
Tuna. See *Opuntia* spp.
Turmeric. See *Curcuma longa*.
Turpentine tree. See *Pistacia mutica*.
Udo, kan. See *Aralia cordata*.
  moyashi. See *Aralia cordata*.
Ulex europaeus, 11758, 12408, 12670, 13241.
Vanilla sp., 14440, 14443 to 14446.
  planifolia, 14441, 14442.
Verbascum phoeniceum, 13618.
Verbena bonariensis, 10723, 10750.
Veronica spicata, 13611.
Vetch, common. See *Vicia sativa*.
  hairy. See *Vicia villosa*.
  Japan. See *Vicia hirsuta*.
  pearl. See *Vicia sativa alba*.
  wild Russian, 10256 to 10258.
  See also *Vicia* spp. and *Lathyrus* spp.
Viburnum dilatatum, 13996.
Vicia sp., 10256 to 10258, 13406 to 13409, 13582, 16192, 16447 to 16451.
  altissima, 14862.
  angustifolia, 13796.
  atropurpurea, 12135, 16452.
  bithynica, 11230, 16453.
  calcarata, 14863.
  cornigera, 16274.
  cracca, 10283, 16454, 16455.
  dasycarpa, 14864.
  disperma, 14865.
  dumetorum, 14866, 16275.
  egyptica, 16456.
  ervilia, 13410.
  faba, 10406, 10411 to 10448, 10535 to 10543, 10724, 10753, 10962, 10991, 11102, 11103, 11697, 11759, 11998, 13411, 13779 to 13785, 14468, 14880, 14881, 15428, 15429, 16457.
  fulgens, 11231, 16458.
  gigantea, 16459.
  grandiflora, 14867.
  hirsuta, 16460.
  hirta, 16461.
  lutea, 16462.
  micrantha, 16463.
  narbonnensis, 11232, 16464.
  pisiformis, 14868.
  sativa, 11233, 11679, 11738, 11764, 11791, 13356, 13412 to 13431, 16466.
    alba, 16465, 16467, 16488.
  sicula, 16468, 16469.
  urvuga, 13432.
  villosa, 11234, 11235, 11677, 11680, 11763, 13433, 14467, 14990, 16191, 16470.
Vigna glabra, 16300.
  sesquipedalis, 16794.
  sinensis, 11074 to 11076, 11090, 11091, 11236, 11344, 11370, 13454 to 13477, 14474, 14499, 16166 to 16168, 16229, 16303, 16795.
Vitis sp., 11372 to 11477, 11492, 11493, 12940 to 12957, 13133.
Vitis coignetiae, 11674.
  gongylodes, 11491.
  rhombifolia, 11490.
  vinifera, 10289 to 10308, 10331 to 10334, 10340 to 10342, 10598 to 10609.
Voandzeia subterranea, 10450, 16473.
Walnut hyb., 10587.
  See also *Juglans* spp.
Wasabi, dry land. See *Eutrema hederaefolia*.
Water lily. See *Nuphar polysepalum*.
Watermelon. See *Citrullus vulgaris*.
Wattle. See *Acacia* spp.
Wheat (Alaska), 10552.
  (Central Asia), 10611, 16327.
  (Egypt), 10382 to 10391.
  (Finland), 10272.
  (Germany), 11731, 14803.
  (India), 14970.
  (New Zealand), 12883 to 12886.
  (Russia), 10194 to 10218, 10318, 10319.
  (Sweden), 10277.
  See also *Triticum* spp.
Whin. See *Ulex europaeus*.
Willow. See *Salix* spp.
Wineberry. See *Rubus* spp.
Woandzu. See *Voandzeia subterranea*.
Wood oil. See *Aleurites cordata*.
Xanthosoma sp., 10594 to 10597, 15377, 15379, 15380, 15383 to 15392, 15394, 15397 to 15401, 15403 to 15412, 15414 to 15421, 15791, 15792, 15803, 16139, 16226, 16778.
  lindeni, 15682, 16496.
  maculatum, 15790.
  robustum, 15793.
  sagittifolium, 13085, 14471, 15417, 15804, 16225.
  violaceum, 15794, 16779.
Xanthoxylum piperitum, 12131.
Yam (Hawaii), 10311 to 10314.
  (Porto Rico), 10590 to 10597.
  See also *Dioscorea* spp. and *Smilax sandwicensis*.
Yang-taw. See *Actinidia* sp.
Yautia. See *Xanthosoma* spp.
Yei-hap. See *Magnolia pumila*.
Yucca sp., 16197.
Zea mays, 10400, 10401, 11106, 12026, 12027, 12383, 12384, 12557 to 12563, 12697, 12939, 13143 to 13153, 13256, 13260 to 13262, 13354, 13357, 13570, 13970 to 13972, 14459, 14465, 14791 to 14798, 14909 to 14921, 14971, 14992, 15775, 16190, 16330, 16770, 16772, 16781 to 16784.
Zephyranthes, 14897, 16150, 16204.
Zingiber officinale, 11086.
Zinnia elegans, 12397, 12982 to 12985.
Zizania aquatica, 16165.
Zizyphus sp., 14882.
  jujuba, 12926.

O

PLATE I.


1
2
3
4
5
6
6 *a*
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

SOY BEAN VARIETIES

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 98.

B. T. GALLOWAY, *Chief of Bureau.*

SOY BEAN VARIETIES.

BY

CARLETON R. BALL,
AGRONOMIST, GRAIN INVESTIGATIONS.

ISSUED MAY 27, 1907.

239412
13. 1. 30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1907.

BUREAU OF PLANT INDUSTRY.

Pathologist and Physiologist, and Chief of Bureau, Beverly T. Galloway.
Pathologist and Physiologist, and Assistant Chief of Bureau, Albert F. Woods.
Laboratory of Plant Pathology, Erwin F. Smith, Pathologist in Charge.
Investigations of Diseases of Fruits, Merton B. Waite, Pathologist in Charge.
Plant Breeding Investigations, Herbert J. Webber, Physiologist in Charge.
Plant Life History Investigations, Walter T. Swingle, Physiologist in Charge.
Soil Bacteriology and Water Purification Investigations, Karl F. Kellerman, Physiologist in Charge.
Bionomic Investigations of Tropical and Subtropical Plants, Orator F. Cook, Bionomist in Charge.
Drug and Poisonous Plant Investigations and Tea Culture Investigations, Rodney H. True, Physiologist in Charge.
Physical Laboratory, Lyman J. Briggs, Physicist in Charge.
Taxonomic Investigations, Frederick V. Coville, Botanist in Charge.
Farm Management Investigations, William J. Spillman, Agriculturist in Charge.
Grain Investigations, Mark A. Carleton, Cerealist in Charge.
Arlington Experimental Farm, Lee C. Corbett, Horticulturist in Charge.
Sugar Beet Investigations. Charles O. Townsend, Pathologist in Charge.
Western Agricultural Extension, Carl S. Scofield. Agriculturist in Charge.
Dry Land Agriculture, E. Channing Chilcott, Expert in Charge.
Pomological Collections, Gustavus B. Brackett, Pomologist in Charge.
Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge.
Experimental Gardens and Grounds, Edward M. Byrnes, Superintendent.
Seed and Plant Introduction, David Fairchild, in Charge.
Forage Crop Investigations, Charles V. Piper, Agrostologist in Charge.
Seed Laboratory, Edgar Brown, Botanist in Charge.
Grain Standardization, John D. Shanahan, Expert in Charge.
Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge.
Subtropical Laboratory and Garden, Miami, Fla., Ernst A. Bessey, Pathologist in Charge.
Plant Introduction Garden, Chico, Cal., Palemon H. Dorsett, Pathologist in Charge.
Cotton Culture Farms, Seaman A. Knapp, Lake Charles, La., Special Agent in Charge.

Editor, J. E. Rockwell.
Chief Clerk, James E. Jones.

FARM MANAGEMENT INVESTIGATIONS.

William J. Spillman, *Agriculturist in Charge.*

Scientific Staff.—F. G. Allison, H. Benton, D. A. Brodie, Lyman Carrier, J. S. Cates, J. S. Cotton, M. A. Crosby, L. G. Dodge, J. A. Drake, David Griffiths, Byron Hunter, C. K. McClelland, H. B. McClure, H. A. Miller, W. A. Peck, C. E. Quinn, S. M. Tracy, C. W. Warburton, J. A. Warren.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., December 14, 1906.

SIR: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 98 of the series of this Bureau the accompanying manuscript, entitled "Soy Bean Varieties."

This paper was prepared by Mr. Carleton R. Ball, now Agronomist in the Grain Investigations of this Bureau, as the result of four years' investigations under the direction of the Agrostologist.

Soy beans have become an important crop in only a few localities in the United States, but in cases where farmers have learned how to utilize them to best advantage they have proved to be a crop of high value. They are especially valuable for mixing with corn for silage, for the production of hay, and for use as pasture, especially for hogs. They possess an advantage over cowpeas in that the growth is erect, and they are therefore easily harvested. Some of the taller sorts may be harvested with an ordinary grain binder.

One reason why soy beans have not become more prominent in American agriculture has been the impossibility of securing seeds of a particular variety. In this bulletin Mr. Ball has given an accurate description of each of the varieties, and where a suitable name has not already been attached to a variety a name is suggested. It is hoped that these varieties may pass into the trade under the names given in this bulletin, so that in the future farmers may be able to obtain from seedsmen the particular kind of soy bean which they wish to plant.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

Page.
Origin and introduction of the soy bean 7
Variability 8
Classification 9
  Key to the varieties 11
Descriptions of the varieties 12
  Black-seeded group:
    Buckshot 12
    Nuttall 14
    Kingston 15
    Ebony 15
    Flat King 16
    Riceland 16
  Brown-seeded group:
    Ogemaw 17
    Eda 18
    Baird 18
    Brownie 19
  Mottled-seeded group:
    Hankow 19
    Meyer 20
  Green-seeded group:
    Samarow 20
    Guelph 20
  Greenish-yellow-seeded group:
    Yosho 21
    Haberlandt 22
    Tokyo 22
  Yellow-seeded group:
    Ito San 23
    Manhattan 24
    Butterball 24
    Amherst 25
    Hollybrook 25
    Mammoth 26
List of synonyms 27
Distribution numbers 27
Description of plates 30

ILLUSTRATIONS.

PLATES.

Page.
PLATE I. Seeds of all varieties of soy beans, in natural sizes and colors.. Frontispiece.
II. Seeds and pods of the black-seeded group 30
III. Seeds and pods of the brown-seeded and mottled-seeded groups..... 30
IV. Seeds and pods of the green-seeded and greenish-yellow-seeded groups 30
V. Seeds and pods of the yellow-seeded group 30

TEXT FIGURES.

FIG. 1. Diagram showing the probable relationships of the different groups of soy beans 10
2. Diagram showing for each variety of soy bean the number of days required to reach maturity and the height of the plant in inches. 13

B. P. I.—237.

SOY BEAN VARIETIES.

ORIGIN AND INTRODUCTION OF THE SOY BEAN.

The soy bean (*Glycine hispida* (Moench.) Maxim.) is an annual leguminous plant from the Orient. Its native home is said to be from southern Japan southward through eastern China and Indo-China to Java. In China and Japan it has been in cultivation for many centuries, certainly since before the beginning of the Christian era. In those countries it is easily the most important legume grown, and in some provinces it is the most important of all crops. Owing, perhaps, to the almost complete isolation of that part of the Orient, its cultivation spread only slowly to other lands. It is now grown to some extent in India, but its introduction there seems to be of recent date. It reached Europe probably in the latter part of the eighteenth century, and its arrival in England is credited to 1790. For several decades it was grown merely as a curiosity in botanic and private gardens. Investigation of the economic value of this plant began more than thirty years ago in Europe, rather earlier than in this country, but the soy bean has not yet attained any great prominence there.

The soy bean has been known in the United States for more than three-quarters of a century. In the New England Farmer of October 22, 1829, Thomas Nuttall wrote of its possibilities as a crop for this country. For many years it was grown only in gardens as a curious plant from the Far East. The Perry expedition to Japan in 1853 brought back two varieties, a yellow and a red sort, which were tested here in a limited way.

During the last twenty years the soy bean has been the subject of many experiments to determine its agricultural value and adaptations. The agricultural experiment stations of Kansas and Massachusetts were pioneers in these investigations and seed was imported directly from Japan by both stations. Through these efforts considerable interest was aroused, and two or three varieties soon became available commercially. The number of forms and varieties in this country was further increased by additional importations made by enterprising seedsmen. Since 1898 the Office of Seed and Plant

Introduction of the United States Department of Agriculture has secured from seven different countries of the old world no less than 65 different lots of soy bean seeds, representing about twenty varieties.

Other experiment stations and some seedsmen and private investigators have also been at work on this crop, and the number of real or supposed varieties has increased very rapidly in this country during the past few years. This general introduction of a new and little-known crop naturally resulted in much confusion concerning the names and characters of the different varieties. In many cases disappointment and loss have been caused to the grower by the lack of this information, and a really valuable crop has been brought into disfavor in some localities.

It is the purpose of this paper to describe and classify all obtainable varieties in such a way as to make them and their adaptations recognizable to farmers, seedsmen, and agricultural experimenters.

VARIABILITY.

The varieties described in the following pages are, of course, not botanical varieties, but agricultural forms, differing in color and size of seeds, in height and habit of plant, and in earliness and lateness of maturing. All these characters, except the color of the seed, vary greatly with the climate and soil. The variation between the products of two different years at the same place is frequently very striking. Every agricultural worker is familiar with the phenomena resulting from sowing southern-grown seed of various crops in the North, and vice versa. In the case of the soy bean, observation shows that the plant reaches a state of equilibrium usually in the second generation, and almost certainly in the third generation.

In the case of imported seeds, where the habit of the parent plant and the conditions under which it grew are generally unknown, it is naturally difficult to tell when equilibrium has been reached. It is certain that many of these imported forms are much smaller in size and of earlier maturity the first year in this country than they are the second year. Some have been discarded at experiment stations after one year of trial as "too dwarf to have any value here," when subsequent trial has shown them to be decidedly large and prolific. Some have not shown their true value until the third year, and perhaps not wholly even then. In some of these importations the variation year by year has been so striking as to arouse a suspicion that the plants are not the same as those of the preceding crop. Such, for example, is Agrostology No. 1299 (see Hollybrook), a yellow soy received from France and first grown in 1902. In that year it reached a height of 12 to 16 inches and ripened in ninety-five days, being classed as a "dwarf early yellow." In 1903 it reached 24 to 28 inches in height and required one hundred and twenty days to reach maturity, and was therefore called a "medium yellow." In 1905 the average height was 30 to 36 inches and one hundred and thirty to one hundred and forty days were needed to reach the mature condition, thus placing it with the "medium late yellow" variety Hollybrook, where it remains. While this is the most extreme case recorded, those somewhat less extreme are quite common.

Considerable variation is frequently noticed in the size of the seeds of a given variety. As might be supposed, the pods and seeds produced on plants dwarfed by drought, thick planting, etc., are generally smaller than those produced on normal plants. In a given season the average size of the seeds may be markedly different from that of the preceding or succeeding season. The seeds from pods produced late in the season are very likely to be noticeably reduced in size.

Most of the different numbers listed under the varieties described have been grown for three years, exclusive of the very unfavorable season of 1904. Some later arrivals have been studied but two years. Bearing in mind, therefore, the range of variation which may be expected and the causes which incite it, the writer can scarcely hope that no errors of classification have been made. He can only trust that whoever pursues this subject far enough to prove such errors will be in a position to understand and overlook them.

The facts stated will explain why such wide range is given in the tables and the descriptions to the average height and the average time required by any variety to reach maturity. Neither the minimum nor the maximum extreme is given in most cases, but rather the limits observed under fairly favorable circumstances. In the region lying between latitude 37° and 43° north and east of the ninety-seventh meridian (the west line of Minnesota and Indian Territory) soy beans are at their best in this country. There they are finding their most prominent and useful place in the agricultural system. In the Gulf region and on the Plains their height is likely to be much reduced, although the seed yield may not be impaired. The reduction in size is often accompanied by earlier maturity. In the Northern States the height reached may be even greater than that specified, but the seed yields are likely to be small and the growing period prolonged, at least until our varieties are more completely acclimated in those States.

CLASSIFICATION.

The first separation of the numerous forms or agricultural varieties of this species will naturally be through the colors of the seeds. The varieties having seeds of the solid colors black and yellow are by far the most numerous and the most striking. The greens and browns are much less common and are also very variable in shade. The browns are of various shades of reddish brown and are also closely related to the mottled group. The yellows vary commonly into greenish shades, and any line drawn between the yellow and greenish yellow is only arbitrary. The yellows also vary into paler shades, and some have even been called "white" in Japan. This is most noticeable in old seeds, but is never carried farther than a pale yellow. It seems likely that none of the legumes commonly cultivated in Japan can have pure white seeds, like our navy beans for example, or the term "white" would never be applied to a pale-yellow form. All yellow soy beans turn gradually paler with age for at least three or four years, although some varieties are originally paler than others. Although the black group shows more variation in the size of the seeds, the yellow is much more variable in color shades and passes into green by some very fine gradations. There seem to be no other characters correlated with seed colors, so that this separation must be made on color alone.

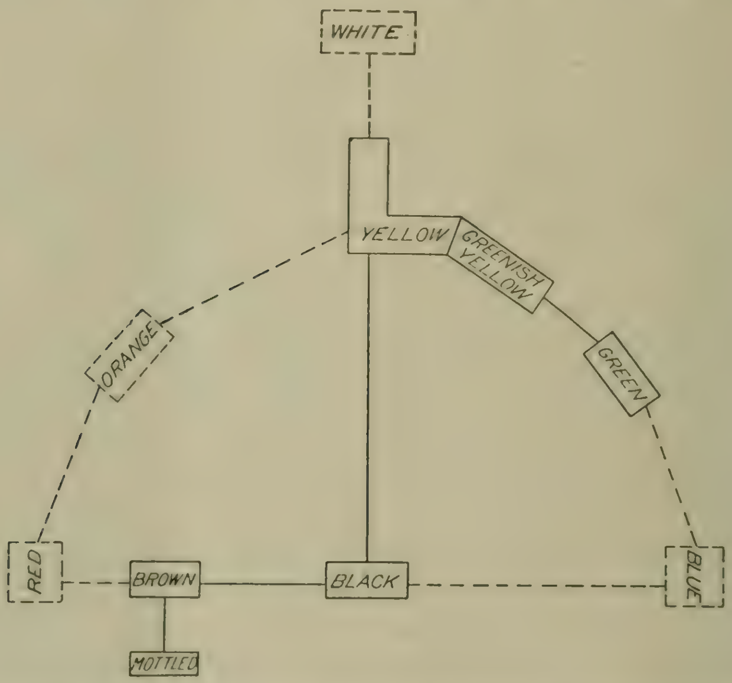


Fig. 1.—Diagram showing the probable relationships of the different groups of soy beans.

Figure 1 shows an attempt to represent graphically the relationships and importance of the various color groups. The solid lines and rectangles represent existing groups and probable relationships; the dotted lines and rectangles indicate possible but still unknown groups or those toward which variation seems to be progressing. The six color groups recognized and described herein are as follows:

I. Black seeded.
II. Brown seeded.
III. Mottled seeded.
IV. Green seeded.
V. Greenish yellow seeded.
VI. Yellow seeded.

KEY TO THE VARIETIES.

It is hoped that the following key will prove useful to those seeking to identify varieties of soy beans. The user is cautioned, however, against placing complete dependence upon the key alone. It should be used only in connection with (1) the table showing average ripening period and average height, (2) the illustrations of seeds and pods, and (3) the fuller notes and descriptions given in the body of the text. From the very nature of these so-called varieties of an agricultural crop they can not be separated by as minute characters as avail in the case of botanical forms.

I. BLACK SEEDED.

1. Seeds large, 8 to 11 mm. long, round or broadly elliptical, pods 1½ to 3 inches long.
   - A. Very early, ninety-five to one hundred days, 18 to 24 inches high, short branched; leaves large, dark; pods 2 inches long or over, seeds spherical or broadly elliptical and somewhat flattened .... *Buckshot.*
   - B. As above, but seven to ten days later, branches longer, pods and seeds somewhat smaller .... *Nuttall.*
   - C. Late, one hundred and twenty to one hundred and thirty days, about 30 inches tall, branches long, seeds very large, elliptical, much flattened. *Flat King.*
2. Seeds small, 4 to 6 or 7 mm. long, round or broadly elliptical, pods about 1 inch long.
   - A. Medium, one hundred and ten to one hundred and fifteen days, low, 15 to 18 inches tall, scarcely branched, seeds spherical or slightly flattened. *Kingston.*
   - B. Medium late, one hundred and fifteen to one hundred and twenty days, 20 to 26 inches tall, long-branched, seeds elliptical, distinctly flattened .. *Ebony.*
3. Seeds medium, elongated, 5½ to 7 mm. long, about two-thirds as wide, much flattened.
   - A. Very late, 3 to 4½ feet tall, very much branched, leaves and pods small. *Riceland.*

II. BROWN SEEDED.

1. Early, pods over 1½ inches long, seeds large, 8 to 9 mm. long, round, or nearly so.
   - A. Very early, about 20 inches high, branches few and short .... *Ogemaw.*
   - B. Early, about 22 inches high, branches very numerous and longer .... *Eda.*
2. Medium late, 25 inches tall, long branched, pods less than 1⅝ inches long, seeds small, 4 to 6½ mm. long, spherical or round.
   - A. Pods distinctly flattened, ⅜ to ½ inch or over in width, seeds deep brown, shining .... *Baird.*
   - B. Pods nearly cylindrical, $\frac{5}{16}$ inch or less in width, seeds light brown, dull. *Brownie.*

III. MOTTLED SEEDED.

1. Identical with Riceland, except in color of the elongated seed .... *Hankow.*
2. Plant not known, seeds large, nearly round .... *Meyer.*

IV. GREEN SEEDED.

1. Early, low, 15 to 20 inches, short branched, pods slender, commonly 3 seeded, seeds light green, elongated .... *Samarow.*
2. Medium, one hundred and ten days, 30 inches tall, pods broader, seeds round, deep green .... *Guelph.*

V. Greenish Yellow Seeded.

1. Early, very low, 14 to 18 inches, pods about 1¼ inches long, seeds medium large, roundish or broadly elliptical, hilum pale brown........................ *Yosho.*
2. Medium late, about one hundred and twenty days, 25 to 30 inches high, branches long, pods and seeds as the last, but hilum deep brown ....*Haberlandt.*
3. Late, one hundred and thirty days or over, 35 inches or over in height, very long branched, pods 1½ inches long, seeds larger, round or elliptical, hilum scarcely tinted...*Tokyo.*

VI. Yellow Seeded.

1. Much-branched plants, branches as long as the main stem; pods small to medium, 1 to 1¼ inches long, often 3 seeded, seeds medium, 5½ to 8 mm. long, round or broadly elliptical, flattened, mostly deep yellow.
   - A. Early, about ninety-five days, 18 to 24 inches tall...................*Ito San.*
   - B. Medium late, one hundred and twenty to one hundred and twenty-five days, 25 to 30 inches tall..*Hollybrook.*
   - C. Later, one hundred and twenty-five to one hundred and thirty-five days, taller, 32 to 42 inches... *Mammoth.*
2. Early, low, about 20 inches, scarcely branched, pods larger, seeds 7 to 9 mm., broadly elliptical, yellow, slightly greenish, hilum brown ....*Manhattan.*
3. Low, stocky, somewhat branched, pods large, seeds large, 7 to 9 mm., spherical or slightly flattened, pale yellow, hilum yellow or pale brown.
   - A. Medium early, one hundred to one hundred and five days, about 20 inches tall, branches short ....*Butterball.*
   - B. Medium late, one hundred and twenty to one hundred and twenty-five days, a little taller, branches nearly equalling stem ....*Amherst.*

Figure 2 shows the average number of days required by each variety from date of seeding to the ripening of the crop and also the average height in inches which the plant attains. The longer, more slender line indicates the range of variation in different seasons and at different stations. It does not, in most cases, show the extremes caused by exceptionally favorable or exceptionally unfavorable conditions. The shorter, heavily shaded line indicates the average performance of the variety under average conditions. Probable exceptions, as in the case of Ogemaw, are noted in the descriptions of the varieties.

DESCRIPTIONS OF THE VARIETIES.

Black-Seeded Group.

BUCKSHOT.

The Buckshot is a well-known commercial variety, having been on the market in this country for a number of years. So far as known, it is the only variety with black seeds which is obtainable commercially. It is quite generally sold by northern seedsmen and under several descriptive names, all more or less similar, as Black, Early Black, Medium Early Black, Extra Early Black, Large Black, etc.

It is a rather low and stout, stocky plant, with short branches and large, very dark leaves. The height is medium, varying from 15 to 28 inches,[a] with the average from

---

[a] The figures given for height indicate the total height of plant, including the upper leaves.

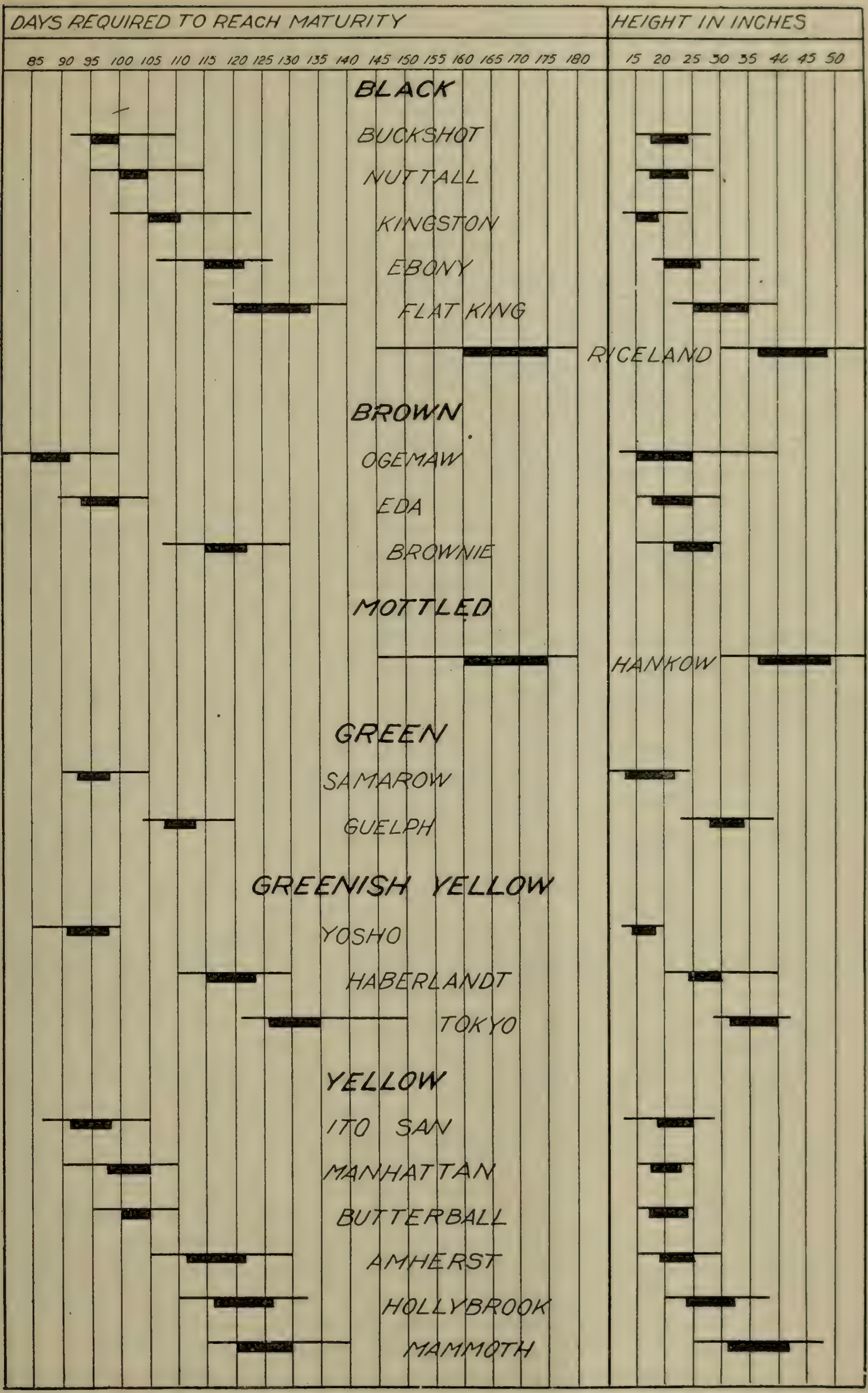


FIG. 2.—Diagram showing for each variety of soy bean the number of days required to reach maturity and the height of the plant in inches. The averages are shown by extra heavy lines.

18 to 24 inches. The stems are of medium thickness, measuring from one-eighth to one-third inch in diameter at the base, with a few (3 to 6) short, appressed branches quite near the ground. On vigorous plants these branches will occasionally be 6 to 10 inches[a] in length. The leaves are large, very dark green in color, broad, and often blunt at the apex. The pods are 2 to 3 seeded, usually 2 seeded, 2 to 3 inches long, one-half inch wide, set very thickly on the short branches and main stalk near its base, often so low as to make harvesting difficult. The seeds are jet black and shining, but usually covered with a powdery bloom, which gives them a dull and grayish, or leaden, color. They are large, 8 to 11 mm. long by 8 to 9 mm. wide, round or very broadly elliptical in lateral view, somewhat flattened when seen in the dorso-ventral view. Seeds from luxuriant vines in moist soil are likely to be somewhat larger and flatter, with the black seed coat wrinkled and sometimes split open.

Although quite widely cultivated in the lower parts of the Northern States, this variety has never become very popular in that section. This seems to be largely due to the fact that the Guelph (medium green), while averaging only ten days later in maturing, also averages 10 inches taller, and is thus considerably more valuable. The Buckshot requires from ninety-two to one hundred and ten days to reach maturity, the average for most locations being ninety-five to one hundred days. It does not mature in the most northern States except in favorable seasons, and then is likely to require about one hundred and twenty days to reach maturity. The name, Buckshot, was suggested by the size, shape, and color of many of the seeds.

Numbers and sources of lots grown.—Agrost. No. 1184, "Black," R. I. Agric. Expt. Station; Agrost. No. 1292, S. P. I. No. 6334, Japan; Agrost. No. 1301, "Early," Johnson & Stokes; Agrost. No. 1303, "Extra Early Black," J. M. Thorburn & Co.; Agrost. No. 1304, W. A. Burpee; Agrost. No. 1471, "Extra Early Black," J. M. Thorburn & Co.; Agrost. No. 1474, "Extra Early Black," Hammond Seed Company; Agrost. No. 1978, union of Agrost. Nos. 1184, 1301, 1304, 1471; Agrost. No. 1979, union of Agrost. Nos. 1292, 1303, 1474; Agrost. No. 2033, "Black," Ark. Agric. Expt. Station; S. P. I. No. 6334, "Round Black," Japan; S. P. I. No. 8491, grown from No. 6334; S. P. I. No. 9412, grown from No. 6334; S. P. I. No. 11179, "Early Black," source not known; S. P. I. No. 17251, union of Agrost. Nos. 1978, 1979, 2033, and S. P. I. No. 11179.

NUTTALL.

This variety is closely related to the Buckshot, but is distinguished by smaller seeds and rather stouter and more branching plants. The stems are stout, from one-third to one-half inch in diameter at the base, and ranging from 15 to 28 inches in height, with the average between 17 and 24 inches. The plants are usually well branched and the branches spreading, nearly closing the spaces between 3-foot rows on good soil. The leaves are large and medium green in color. The pods are 2 to 3 seeded, but rather more than usual contain 3 seeds each, and occasionally there is one with four seeds. From 2 to 4 pods are borne on each peduncle. The pods are medium, about 2 inches long, one-fourth to three-eighths inch wide, often not turning brown until after the seeds are ripe. The pods do not dehisce readily, commonly remaining closed until the seed is fully ripe. The seeds are jet black and shining; with usually little or no powdery bloom, medium to large in size, 7 to 9 mm. long, 6 to 8 mm. wide, round or broadly elliptical in outline from a lateral view, distinctly flattened from the dorso-ventral view. The Nuttall requires from one hundred to one hundred and fifteen days to ripen its seeds, the average time being one hundred and five to one hundred and ten days. This variety has apparently but very little to recommend it. It is later than the Buckshot, and, though well branched, the total height is not increased, so in that respect it can not compare with the Guelph variety. In seed yields, where sown thickly enough to make fair forage, it has not done much. From 4 to 6 bushels to a little more than 12 bushels to the acre are the recorded outputs.

---

[a] The figures given for the length of branches are for the naked branch only. With leaves attached the branches are from 7 to 9 inches longer.

The name is given in honor of Thomas Nuttall, who wrote the first recorded account of the soy bean in this country.

Numbers and sources of lots grown.—Agrost. No. 1536, S. P. I. No. 6416; S. P. I 6416, "Black," from Korea; S. P. I. No. 8496, grown from S. P. I. No. 6416; S. P. I. No. 9418, grown from S. P. I. No. 8496; S. P. I. No. 17253, grown from Agrost. No. 1536–1.

KINGSTON.

This is a small, medium early variety, with rather slender stems, one-eighth to three-eighths inch in diameter at the base, and 12 to 24 inches high. The average height is 16 to 18 inches. The stems are either unbranched or with three to six short appressed branches at the base, 1 to 2 inches long. The general color of the foliage is from a medium to dark green, and the leaves are large and less pointed than in Ebony. The pods are very small, averaging smaller than those of Ebony, three-fourths to 1 inch in length and one-fourth inch in width, 2 to 3 seeded, borne very thickly on the main stem, often to within 2 inches of the ground. The full-grown but still unripe pods bear a strong resemblance to young peanut pods, being cylindrical and considerably constricted between the seeds. The seeds are the smallest of any black variety, and are equaled in smallness by the Brownie only. They are entirely round in outline, no long diameter being discernible, 4½ to 6 mm. broad, jet black and shining, with only a slight bloom, and only moderately flattened in dorso-ventral view.

This variety is too small and unbranched to have much value for forage. It is likely to prove a fairly good yielder of seed, two tests sown thickly for forage having yielded between 8 and 9 bushels of seed per acre. In time of ripening it is medium early, requiring from one hundred and four to one hundred and twenty-two days, or averaging one hundred and ten to one hundred and fifteen days.

The name, Kingston, is given in honor of the Rhode Island Experiment Station, located at Kingston, R. I. That station has contributed largely to our knowledge of the soy bean as a crop for northern regions, and this variety was received from that source alone.

Numbers and sources of lots grown.—Agrost. No. 1188, "Japanese No. 15," R. I. Agric. Expt. Station; S. P. I. No. 17255, grown from Agrost. No. 1188–1.

EBONY.

The very small-seeded variety known as Ebony is not to be had on the market, and it has apparently been obtained abroad but once. The original importation was from Ping-yang, Korea. In size of seed and pod it is, with the exception of Kingston, the smallest of all the black soy beans and one of the few very small-seeded varieties of any color.

The Ebony variety is characterized by rather slender stems, one-eighth to one-fourth inch in diameter at the base and 18 to 36 inches tall, erect, and usually well branched. The branches are long and slender, spreading at an angle of about 45°, thus giving the plant a very bushy habit. The leaves are small to medium in size, averaging 1½ to 2½ inches long, and are medium green in color. A good crop of pods is borne on stem and branches alike. The pods are very small, three-fourths to 1 inch in length by one-fourth inch in width, each containing 2 or rarely 3 seeds. The seeds are small, jet black, shining, with scarcely any trace of bloom, round to broadly elliptical in outline, mostly the latter, 5 to 6½ or 7 mm. long, 4½ to 5½ or 6 mm. wide, rather more variable than in the other black varieties, quite distinctly flattened in dorso-ventral view.

The growth the first season was small but plants of the second and third generations were 18 to 36 inches high, according to locality. This variety closely resembles the Nuttall in habit of growth, but is much later in maturing and has very much smaller pods and seeds. It has, apparently, the bad habit of not holding its leaves well until the pods are ripe, and it is not likely to be regarded as of value unless that fault is eliminated by selection. As a hay crop, designed to be cut before fully mature, it would do very well. The other characters, such as slender stems, fair height, and long, slender branches, as well as a good crop of pods, all mark it as of probable value for hay. It requires from one hundred and seven to one hundred and twenty-seven days to reach maturity, the average being from one hundred and fifteen to one hundred and twenty-two days.

The name has reference to the color of the seeds.

Numbers and sources of lots grown.—Agrost. No. 1193, S. P. I. No. 6386; Agrost. No. 1541, S. P. I. No. 8492; Agrost. No. 1980, Agrost. Nos. 1193 and 1541, united; S. P. I. No. 6386, "Black," Korea; S. P. I. No. 8492, grown from S. P. I. No. 6386; S. P. I. No. 9414, grown from S. P. I. No. 8492; S. P. I. No. 17254, grown from Agrost. No. 1980.

FLAT KING.

The Flat King is a tall and quite stout variety, with stems one-half inch in diameter at the base, often branching quite freely, 20 to 30 inches high in drier regions, 30 to 40 inches in more favorable localities. The branches are 5 to 7 in number, the lower ones 10 to 14 inches long, the upper 4 to 8 inches, ascending or spreading, nearly meeting across the spaces between rows 3 feet and more apart. The leaves are large, abundant, and medium to dark in color. This variety bears usually a heavy crop of pods, but these are commonly quite close to the ground, making harvesting rather difficult, especially where the plants are low. The pods are large, 2 to 2½ inches long, one-half inch wide, usually loosely 2 seeded. The seeds are larger and flatter than those of any variety, jet black, shining, with little or no bloom, flat, broadly elliptical in outline, 7 to 9 mm. wide, 8 to 12 mm. long, a common size for well-developed beans being 8 by 11 mm., only 3½ to 4 mm. thick, occasionally somewhat pointed at the ends.

The Flat King is a very strong-growing variety, resembling the Nuttall more closely than any other black-seeded form, though the Flat King is the taller, its average height being from 25 to 35 inches. It is not a commercial variety yet, but its heavy crop of pods, its large size, and branching habit make it a valuable variety for trial as a silage crop or for a cover crop or hog pasture, especially in the Southern States. It is later than any of the large and promising varieties, except the Tokyo, and is more comparable with the Mammoth in time of maturity, requiring from one hundred and seventeen to one hundred and forty days or even more in unfavorable seasons. Yields of seed of from 6 to 9 bushels to the acre have been recorded.

The name is given on account of the much flattened seeds and the large size of seeds and plants.

Numbers and sources of lots grown.—Agrost. No. 1293, S. P. I. 6312; S. P. I. No. 6312, "Flat Black," Japan; S. P. I. No. 8497, grown from S. P. I. No. 6312; S. P. I. No. 9410, grown from S. P. I. No. 8497; S. P. I. No. 17252, grown from Agrost. No. 1293–2.

RICELAND.

This is one of two very peculiar varieties imported from China. These two, the Hankow being the second one, are very similar in habit, differing only in the color of the seeds. They are, however, quite different from all other varieties studied. In appearance they scarcely suggest the familiar type of soy beans. Where sufficient moisture may be had they attain the greatest height of any varieties yet grown.

The main stem is stout at the base, one-fourth to one-half inch in diameter there, but soon becomes reduced in size and flexuous or somewhat twining in habit. It is then no longer distinguishable from the larger branches. The entire plant reaches a height of from 3 to 5 feet. The long slender branches spring abundantly from the whole length of the stem. They frequently equal or even exceed the main stem in length, and are themselves repeatedly branched. The long lower branches are inclined to become prostrate unless the rows are close enough together to give some support one to another. The tips of the branches become actually twining and often tangle themselves together. The leaves are very small, only 1 to 2 inches in length, narrow, medium green to light green in color. The pods also are very small, scarcely 1 inch long by about one-fourth inch wide. They are scattered quite uniformly over the long stem and branches. The seeds are medium small and elongated in proportion to their width, jet black, shining, the original seed so heavily coated with powdery bloom as to obscure the ground color entirely, the generations grown in this country much less thickly covered, narrowly elliptical, 4 to 5 mm. wide, 5½ to 7 mm. long, a common size being 4½ by 6½ mm., very much flattened, only 2½ to 3 mm. thick.

The Riceland has not yet been placed on the market. It is known only from the original importation from beyond Chiu Niu, near Hankow, province of Hupeh, in the great valley of the Yangtze, China, where it is sown in July or August, between the rows of rice. It ripens late in the fall after the rice is harvested. It is thus accustomed to very wet soils. In the trials made in this country it has required from one hundred and fifty to one hundred and eighty days to reach maturity. It is probable, however, that if treated here as in China, viz, planted late in wet ground, it would still come to maturity before frost, at least in the South, and in a considerably shorter period than if sown earlier. Its numerous slender branches, fine foliage, and tall growth are indicative of great value as a hay plant. It does not do well at all in dry regions and should be tested only on moist or wet soils. It is worthy of very careful trials under these conditions.

S. P. I. No. 16790 from Hangchow, China, is probably another lot of this striking variety. This lot has not been grown by the writer, but it is characterized by the same narrowly elliptical, flattened seeds. They average slightly larger than those just described, some reaching 5 by 8 mm. Hangchow is also in the rice-growing section of China.

The name, Riceland, is suggested by the use of this variety by the Chinese in their rice fields.

Numbers and sources of lots grown.—Agrost. No. 964, S. P. I. No. 6560; S. P. I. No. 6560, from beyond Chiu Niu, near Hankow, China.

BROWN-SEEDED GROUP.

OGEMAW.

The Ogemaw soy bean has recently been brought to public notice and put on the market by Mr. E. E. Evans,[a] of West Branch, Mich., as an extra early form for northern latitudes. The writer has had it under test for only one season, that of 1905. In all trials made, mostly in the middle South and Southwest, it has shown itself to be a dwarf and stocky early variety. Since the well-known effect of sowing northern-grown seed in the South is to check its vegetative vigor for at least one season, it may be assumed that the Ogemaw is likely to have a greater average height than it reached last year, which was only 10 to 20 inches. In Upper Michigan it has been reported to have an average height of 38 inches, which is well toward the other extreme. It is likely that further trials will prove the Ogemaw identical with the next variety, Eda, except perhaps in time of ripening.

---

[a] Mr. Evans spells the name "Ogema," which is likely to prove confusing in pronunciation to those unfamiliar with the name. Prof. C. D. Smith, director of the Michigan Experiment Station, states that the name was derived from the county "*Ógemaw*," and the writer prefers the longer spelling as being more likely to be correctly pronounced.

The Ogemaw soy bean has stems of medium size, one-fourth to three-eighths inch in diameter at the base, freely branching, with short and usually appressed branches 2 to 4 inches long, thickly set with brown pods, 1½ to 2 inches long, three-eighths to one-half inch wide, 2 to 3 seeded, usually becoming brown before the seeds are ripe, and with an unfortunate tendency to shatter easily, even before fully mature. The seeds are large and plump, round or very broadly elliptical in outline, 8 to 9 mm. long, 7 to 9 mm. wide, somewhat flattened in cross section. In color they are a deep brown when mature. Before maturity they are light brown. A sample is likely to contain seeds in various stages of ripeness, and hence to present all shades of brown in color, sometimes on a single seed. Stored seed becomes darker with age. Mature seeds are commonly quite shiny. The Ogemaw is one of our very earliest varieties, ripening in from eighty-two to one hundred days, with the average somewhere about eighty-eight to ninety days. It has not shown itself a specially heavy yielder of seed, due partly to the early dehiscence of the pods and shattering of the seeds.

Numbers and sources of lots grown.—Agrost. No. 1992, "Ogemaw," E. E. Evans, Mich.; Agrost No. 2031, "Crossbred No. 6," Ark. Agric. Expt. Station; S. P. I. No. 13502, Agrost. No. 1992; S. P. I. No. 17258, grown from Agrost. No. 1992; S. P. I. No. 17259, grown from Agrost. No. 2031.

EDA.

The Eda variety is very similar to the Ogemaw and is likely to prove identical with it when the Ogemaw has become more fully acclimated and has regained its normal size. The Eda differs from the Ogemaw variety chiefly in its greater height, longer branches, and in being a week or so later in maturing. In short, it is a larger and more vigorous plant, which the Ogemaw is likely to equal in another trial with home-grown seed.

The Eda is a medium-sized, well-branched plant, from 16 to 30 inches high, branches 6 to 12, more numerous than in any other small variety, the lower ones 6 to 10 inches long, erect appressed, and therefore not giving the plant a bushy appearance. Stems and branches podded well, but not too close to the ground; pods 1¼ to 1¾ inches long, three-eighths to one-half inch wide. Fairly early, maturing in from one hundred to one hundred and ten days. The seeds are almost identical with those of Ogemaw, round or broadly elliptical, 7 to 9 or 10 mm. long by 7 to 9 mm. broad, deep brown, shiny, but usually covered with more or less powdery bloom, which gives them a dull appearance.

The plat of this variety grown at the Tennessee Experiment Station in 1905 had foliage of a most striking and peculiar coppery-green color not observed in any other plat.

The name, Eda, is a part of the longer name under which this variety was received.

Numbers and sources of lots grown.—Agrost. No. 1185, "Brown Eda Mame," R. I. Agric. Expt. Station; S. P. I. No. 17257, grown from Agrost. No. 1185-1.

BAIRD.

The seed of this variety was mixed with the original and only importation of the Brownie variety, described later. In all the brown varieties, except the Brownie, the seeds are deep brown when ripe, but light brown when nearing maturity. For this reason the light brown seeds of the Brownie and the deep brown seeds of the Baird varieties were thought to represent the immature and mature seeds, respectively, of a single variety, which was called Brownie.

The Baird variety is readily distinguished from the Brownie by its slightly larger and more flattened deep brown seeds. The pods also are distinctly larger and more flattened, three-eighths to one-half inch or more in width, 1⅛ to 1⅜ inches in length, apparently remaining nearly yellow at maturity.

The characters of the plant have not been recorded, but it is probably coarser and less branched, though earlier, than that of the Brownie variety. From the Ogemaw and Eda varieties it is separated by its smaller pods and much smaller seeds. It is probably much like them in habit, but longer branched and later.

As this variety was separated from the Brownie after the plates were prepared, its name does not appear on Plate III. It is, however, represented by the two left-hand seeds in No. 9 on Plate I and by the four left-hand seeds and the lower pod attributed to the Brownie variety on Plate III, as noted in the description of the plates.

The variety is named for Rev. W. M. Baird, a missionary, who secured the seed in Korea.

BROWNIE.

This is a well-branched, bushy variety, with very small pods and seeds. It is not known commercially, but only through the original importation from Korea.

The stems are medium in size, one-fourth to three-eighths inch in diameter at base, bearing 3 to 6 branches, the lowermost 15 to 20 inches long, the upper gradually shorter, all ascending or spreading, giving to the plant a bushy, wide-spreading habit. Leaves of medium size and medium to light green in color. Pods borne quite abundantly, 3 to 6 to the cluster, very small, nearly cylindrical, three-fourths inch to 1¼ inches long, three-sixteenths to five-sixteenths inch wide, 2 or occasionally 3 seeded, remaining greenish yellow until nearly ripe, then becoming somewhat reddish. The seeds are all round or spherical, 4 to 6½ mm. in diameter, the normal color a light brown, resembling the seeds of some forms of the gram (*Phaseolus mungo*).

From one hundred and eight to one hundred and twenty-five or more days are required to bring this variety to maturity, the average being about one hundred and fifteen to one hundred and twenty days. The longer periods seem to be accompanied by a considerably taller growth, and it seems likely that with careful selection this variety can be developed into a very valuable hay plant. The few yields of seed recorded are all small, usually less than 5 bushels to the acre.

The name is derived from the color and small size of the seeds.

Numbers and sources of lots grown.—Agrost. No. 1542, S. P. I. No. 6414; S. P. I. No. 6414, from Ping-yang, Korea; S. P. I. No. 9417, grown from S. P. I. No. 6414; S. P. I. No. 17256, grown from Agrost. No. 1542–1.

MOTTLED-SEEDED GROUP.

HANKOW.

The description and notes already given for the Riceland apply equally well to the Hankow variety, except for the color of the seeds. Both were obtained in China at the same time and place and were noted as being grown in the same way for the same purpose. In all the tests made they have behaved exactly alike. The seeds are of medium size, rather narrowly elliptical, 4 to 5½ mm. wide by 6 to 8 mm. long, 5 to 6½ mm. being a common size. The ground color is light to medium brown and the mottling is black. The black is present usually as a more or less sharply defined patch or saddle of varying size and elliptical shape on either side of the "eye," or hilum. In addition, there are usually one or two narrow or broader eccentric lines or stripes of black outside the patch and parallel to its edge, thus forming a broken ellipse near the margin of the flattened seed. The two sides of a bean are frequently unlike in their markings.

S. P. I. No. 9344, from China, has very similar seeds, rather plumper, and much discolored, but with more dark color than in the variety just described. The black is usually massed as a saddle around the eye and extending outward over about half or more of the surface. This serial number has not been tested by the writer, and its characteristics are not known.

The name is derived from the city of Hankow.

Numbers and sources of lots grown.—Agrost. No. 972, S. P. I. 6559, from Chiu Niu (near Hankow), China.

MEYER.

S. P. I. No. 17852 is a recent importation from China, secured by Mr. F. N. Meyer. From the seed alone it is certain that this is a distinct variety of the mottled group. The seeds are plump and shiny, broadly elliptical, 6½ to 8 mm. broad, 7 to 10 mm. long, the ground color deep brown, with patches or blotches of black on either side near the hilum and eccentric curved lines or stripes of the same color near the dorsal edge. The amount of this black color is quite variable, some seeds being quite covered with it and some showing only faint lines of it.

GREEN-SEEDED GROUP.

SAMAROW.

Samarow is a dwarf early variety of unknown origin. It has been sold for several years by J. M. Thorburn & Co., New York, under the name Green Samarow. It may readily be distinguished from all other varieties by the elongated, flattened, light-green seeds, quite different in shape from those of any varieties which are similar in color.

The stems of the Samarow variety are slender, one-eighth to one-fourth inch in thickness at the base, 10 to 24 inches tall, well branched with short branches, the lower ones only 4 to 5 inches long, ascending or spreading; leaves broad but not large, generally very dark green. The stem and branches are thickly set with medium-sized pods, 1¼ to 1¾ inches long by one-fourth to one-third inch wide, 2 to 4 seeded; often one-half of the pods on a plant will contain 3 seeds each, which is a higher proportion than has been observed in any other variety, while pods containing 4 seeds each are not uncommon. The seeds are elliptical, distinctly elongated, or some almost reniform (kidney-shaped), 5 to 6½ mm. wide by 7 to 9 mm. long, dull to faintly shining, very pale green or pea green in color. The variety may be easily recognized by the elongated, pale green seeds, the only other elongated seeds being black or mottled.

The Samarow soy bean requires from ninety to one hundred and five days to come to full maturity, the average being about ninety-five days. It is a fair to good yielder of seed and it is for this purpose that it is likely to be grown. The yields reported run from 5 to nearly 15 bushels per acre. The small size of the plants makes it unprofitable to grow for forage production, but the abundant crop of pods, containing 3 seeds commonly and 4 occasionally, suggests the possibility of breeding for high seed yields.

Numbers and sources of lots grown.—Agrost. No. 1302, "Green Samarow," J. M. Thorburn & Co.; Agrost. No. 1470, "Green Samarow," J. M. Thorburn & Co.; Agrost. No. 1972, "Green Samarow," union of Agrost. Nos. 1302 and 1470; S. P. I. No. 17260, grown from Agrost. No. 1972.

GUELPH.

The Guelph is one of the oldest and best known of the varieties in cultivation. For many years it has been sold by numerous seed houses as Early Green, Medium Green, and Medium Early Green. It is a rather curious fact that during the eight years in which the United States Department of Agriculture has been actively engaged in the introduction of oriental legumes it has but once secured this variety. This is probably due to the fact stated by writers on Japanese agriculture that the green-seeded and the brown-seeded forms are but sparingly cultivated in the Orient, the blacks and yellows being much preferred.

The Guelph soy bean has become quite a favorite in the Northern States of this country, where it is highly esteemed for both seed and forage production. In Kansas, Indiana, Michigan, and in Ontario it has given splendid results in comparative tests extending through several years.

The Guelph variety grows from 24 to 38 inches high, stems medium stout, one-fourth to three-eighths inch in diameter, well branched with ascending or spreading branches, 6 inches long at the bottom, often completely filling the space between rows 3 to $3\frac{1}{2}$ feet apart. The leaves are very dark green, large and full in the center, with the margin often much wrinkled or crinkly, due to vigorous but uneven growth of the different parts of the leaf. The pods are medium in size, 1 to $1\frac{1}{2}$ inches long by three-eighths inch wide, 2 to 3 seeded, borne thickly on the main stem and branches and usually far enough above the ground to permit easy harvesting. The seeds are nearly round in outline, 6 to 8 mm. in diameter, distinctly flattened, 4 to 5 mm. thick in dorso-ventral view. In color they are bright green and quite shiny.

The Guelph variety is medium in time of ripening, varying from one hundred and five to one hundred and twenty days, one hundred and eight to one hundred and fourteen days being the average time. Six lots of this variety tested at the Kansas Experiment Station in 1903 all ripened in one hundred and seven days, yielding from $3\frac{3}{5}$ to $10\frac{1}{5}$ bushels of seed to the acre and averaging $6\frac{1}{2}$ bushels. Eight lots tested at Washington the same year matured in one hundred and five to one hundred and fifteen days, yielding from $5\frac{2}{5}$ to $14\frac{1}{10}$ bushels to the acre, the average being $8\frac{2}{5}$ bushels. Yields of from 16 to 18 bushels were secured in Indiana. At the Ontario Experiment Farm the average annual yield of green fodder for a period of four years was 11 tons to the acre. Virginia and Delaware report yields of 7 to 10 tons of green forage to the acre. This variety shatters rather badly if allowed to become fully ripe, which is an objection to its use as a seed crop. Its large size and freely branching habit make it a most excellent variety for pasture, hay, silage, and cover crop, and for these purposes it should be widely grown.

At the Ontario Agricultural College and Experiment Farm, located at Guelph, Ontario, a great deal of work has been done with soy beans, and with this variety especially, and the name is given for that reason.

Numbers and sources of lots grown.—Agrost. No. 912, "Early Green," J. M. Thorburn & Co.; Agrost. No. 969, S. P. I. No. 6558; Agrost. No. 1306, "Medium Early Green," J. M. Thorburn & Co.; Agrost. No. 1312, "Medium Green," Henderson & Co.; Agrost. No. 1464, "Early Green," Henderson & Co.; Agrost. No. 1467, "Medium Early Green," J. M. Thorburn & Co.; Agrost. No. 1469, "Medium Early Green," Breck & Sons; Agrost. No. 1473, "Medium Early Green," Hammond Seed Co.; Agrost. No. 1476, "Medium Early Green," Currie Bros.; Agrost. No. 1764, "Early Green," Kans. Expt. Station; Agrost. No. 1971, "Medium Green," union of Agrost. Nos. 912, 969, 1306, 1312, 1464, 1467, 1469, 1473, and 1476; S. P. I. No. 6558, Hankow, China; S. P. I. No. 13503, Agrost. No. 912; S. P. I. No. 17261, grown from Agrost. Nos. 1764 and 1971.

GREENISH-YELLOW-SEEDED GROUP.

YOSHO.

The Yosho is a rather small, early form, with small stems, one-fourth inch in thickness, 12 to 30 inches high, with a few rather short branches, 2 to 4 inches long, rather stocky and bushy in appearance. Leaves large, medium green in color; pods only fairly abundant, medium sized, $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long by three-eighths inch or more wide, 2 or occasionally 3 seeded. The seeds are medium to large in size, $6\frac{1}{2}$ to $7\frac{1}{2}$ mm. wide, 7 to 8 mm. long, nearly round or broadly elliptical, somewhat flattened, greenish yellow and shining when fresh, becoming paler and duller with age, the hilum marked with pale brown.

Yosho is a very early variety, maturing in eighty-five to one hundred days, averaging ninety-two to ninety-seven days. It gives only a fair yield of seeds and a low yield of vines. Seed yields of $4\frac{3}{5}$ to $6\frac{3}{5}$ bushels per acre are recorded.

The name is formed by shortening the Japanese word Yoshioka.

Numbers and sources of lots grown.—Agrost. No. 1297, S. P. I. No. 6314; S. P. I. No. 6314, "Yoshioka," Japan; S. P. I. No. 8489, grown from S. P. I. No. 6314; S. P. I. No. 17262, grown from Agrost. No. 1297–2.

HABERLANDT.

The stems are medium size, one-fourth to three-eighths inch in diameter at the base, 20 to 40 inches in height, the average being 24 to 30 inches, well provided with numerous long, ascending to rather wide-spreading branches, the lower ones from 6 to 12 inches or more in length; the leaves medium to broad, narrowed toward the tip, medium to light green in color. A plot grown in 1905 at Baton Rouge, La., had foliage of a very light glaucous green, much resembling a plot of rape in color. The same appearance was also reported for this variety by the Virginia Agricultural Experiment Station. The stem and long branches are well set with pods $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long and three-eighths to one-half inch wide. The seeds are medium or large, the present generation (1905) nearly round, $6\frac{1}{2}$ to 8 mm. wide by 7 to 8 mm. long, clear greenish yellow, shining, decidedly paler when two or three years old, the third generation back from the present larger and longer, 7 to 8 mm. wide by 7 to $9\frac{1}{2}$ mm. long, all somewhat flattened; hilum deep brown.

The time required for this variety to reach maturity varies from one hundred and ten to one hundred and thirty days, the average time being somewhere near one hundred and eighteen to one hundred and twenty days. Two seed yields secured were $12\frac{9}{10}$ and $13\frac{3}{10}$ bushels to the acre, respectively. The Haberlandt is one of the most promising varieties for hay, silage or green manuring, and for a cover crop. From the Tokyo it can be distinguished only by its earlier maturity, rather deeper greenish yellow seed and distinctly brown hilum.

This variety was named in honor of Prof. A. Haberlandt, who first brought the soy bean to agricultural notice in Europe. His work was published in 1878 at Vienna.

Numbers and sources of lots grown.—Agrost. No. 1194, "White," S. P. I. No. 6396; Agrost. No. 1539, S. P. I. No. 8495; Agrost, No. 1540, S. P. I. No. 8493; S. P. I. No. 6396, "White," Ping-yang, Korea; S. P. I. No. 6397, Ping-yang, Korea; S. P. I. No. 8493, grown from S. P. I. No. 6396; S. P. I., No. 8495, grown from S. P. I. No. 6397; S. P. I. No. 9415, grown from S. P. I. No. 8493; S. P. I. No. 9416, grown from S. P. I. No. 6397; S. P. I. No. 17263, grown from Agrost. No. 1539–1; S. P. I. No. 17271, grown from Agrost. No. 1194–1.

TOKYO.

The Tokyo differs from the medium greenish yellow (Haberlandt) variety mostly in a somewhat more vigorous growth and in later ripening. It is a very large and vigorous, long-branched variety; stems one-fourth to one-half inch in thickness, 28 to 42 inches in height. In this it scarcely excels the best records for the Haberlandt, but in the average height reached, about 36 inches, it considerably overtops that variety. The branches are 5 to 10 in number, the lower ones 10 to 15 inches long, ascending or spreading, the plant bushy enough to completely close the spaces between $3\frac{1}{2}$-foot rows, inclined to be top-heavy and to lodge somewhat where grown thinly. The leaves are large, 3 to 4 inches long, 2 to $2\frac{1}{2}$ inches wide, medium to very dark green in color. The pods are large, 1½ to 2 inches in length, about one-half inch in width, 2 to 3 seeded. Seeds large, 7 to 9 mm. wide by 7 to 10 mm. long, round or broadly elliptical, somewhat flattened or occasionally spherical, greenish yellow, shiny, paler and duller with age. The seed of later generations is noticeably smaller than that of the earlier ones, probably due to too thick planting of so large a variety and to forcing maturity in a shorter growing season.

The Tokyo is one of the very best varieties for all-round use. It will give heavy hay and silage crops, is equally good for pasture and cover-crop purposes, and where it matures it gives very good seed yields. Eight plots grown at Washington in two different years averaged 8⅓ bushels of seed per acre, in which the lowest yield was 4 bushels and the highest 14½ bushels. The Kentucky Agricultural Experiment Station reports a very much higher seed yield, with the weight of green forage to the acre 11.84 and 14.08 tons from two plots, curing to 5.44 and 6.16 tons, respectively. It is too late for the best results in most Northern States, but it may be replaced there by the Haberlandt variety.

This variety was named for the Japanese capital, where some of the importations were secured.

Numbers and sources of lots grown.—Agrost. No. 468, grown from S. P. I. No. 4914; Agrost. No. 696, grown on Potomac Flats; Agrost. No. 1171, "Best Green," S. P. I. No. 9409; Agrost. No. 1198, "Late Ita Name," S. P. I. No. 8424, Japan; Agrost. No. 1200, "Medium Ita Name," S. P. I. No. 8423, Japan; Agrost. No. 1298, "Medium Green," S. P. I. No. 6335, Japan; S. P. I. No. 4914, "Best Green," Japan; S. P. I. No. 5766, grown from No. 4914; S. P. I., No. 6335, "Medium Green," Japan; S. P. I., No. 8423, "Medium Ita Name," Japan; S. P. I. No. 8424, "Late Ita Name," Japan; S. P. I. No. 9409, grown from S. P. I. No. 5766; S. P. I. No. 17264, grown from Agrost. No. 1198–1; S. P. I. No. 17265, grown from Agrost. No. 1200–1; S. P. I. No. 17266, grown from Agrost. No. 1171–1; S. P. I. No. 17267, grown from Agrost. No. 1298–2.

YELLOW-SEEDED GROUP.

ITO SAN.

Ito San is probably the best known variety of soy bean on the market. The original source of the variety is not known, but it was very probably one of the early importations made by the Kansas and Massachusetts agricultural experiment stations; perhaps by others also. It has been long and widely sold under the names "Yellow," "Early Yellow," "Early White," etc. It is said that the name "Ito San" was given it by Mr. E. E. Evans, of West Branch, Mich. The greatest value of the Ito San lies in its earliness and fairly large yield of seeds. It is too small to yield heavily for hay, silage, etc. It remains, however, one of the most popular varieties on the northern market.

The Ito San is a rather small, early variety, with slender stems about one-fourth inch in thickness at the base, 12 to 28 inches high, the average being 18 to 24 inches; the branches are long and numerous, ascending or erect, nearly or quite equaling the main stem in height; leaves small to medium, narrow, light green to almost a bluish or glaucous green; pods scattered along the whole length of the main stem and the branches, slender, 1¼ to 1¾ inches long, three-eighths inch wide, 2 or often 3 seeded. The seeds are small, 5 to 6½ mm. wide, 5½ to 7 mm. long, round or slightly elliptical, a pale lemon-yellow, scarcely shiny when fresh, becoming paler and duller with age, hilum occasionally brownish, but normally yellow.

Ito San commonly matures in from ninety to one hundred days, with the average between ninety and ninety-five days. Occasionally it ripens in less than ninety days, and in cold, wet seasons it will require more than one hundred days. It is rather too small for best results as a hay and silage crop, except where quick returns are desired. The Kentucky Agricultural Experiment Station reports 5$\frac{3}{10}$ tons of green fodder per acre, curing to 1½ tons. In Ontario, Canada, the average height for four years was 27 inches and average yield of green hay 8½ tons. In 1903 the Kansas Agricultural Experiment Station secured yields of 14½ to 15$\frac{7}{10}$ bushels of seed from four different plats. All showed a high percentage of nondehiscence of the pods—88 to 96 per cent. At the Massachusetts Agricultural Experiment Station the seed yields have varied between 18 and 20 bushels in favorable years.

Numbers and sources of lots grown.—Agrost. No. 658, "Kaiyuski Daizu;" Agrost. No. 1183, "Adzuki," R. I. Agric. Expt. Station; Agrost. No. 1186, "Yellow;" Agrost. No. 1187, "Early White," R. I. Agric. Expt. Station; Agrost. No. 1189, "Yellow Eda Mame," R. I. Agric. Expt. Station; Agrost. No. 1192, "Kiyusuke Daidzu," R. I. Agric. Expt. Station; Agrost. No. 1294, "Rokugatsu," S. P. I. No. 6326; Agrost. No. 1313, "Ito San," J. M. Thorburn & Co.; Agrost. No. 1316, "Early," F. Barteldes & Co.; Agrost. No. 1468, "Ito San," J. M. Thorburn & Co.; Agrost. No. 1475, "Ito San," Hammond Seed Co.; Agrost. No. 1478, "Early Yellow," Currie Bros.; Agrost. No. 1765, "Early Yellow," Kansas Agric. Expt. Station; Agrost. No. 1973, union of Agrost. Nos. 1183, 1186, 1187, 1294; Agrost. No. 1974, union of Agrost. Nos. 1189, 1192, 1316, 1478, 1540; Agrost. No. 1975, union of Agrost. Nos. 1316, 1468, 1475; S. P. I. No. 6326, "Rokugatsu," Japan; S. P. I. No. 17268, grown from Agrost. Nos. 1765, 1973, 1974, 1975.

MANHATTAN.

The Manhattan is a dwarf early variety with medium stems 15 to 24 inches high, averaging about 20 inches, stocky, branches short and ascending; leaves medium to large, dark green in color; pods numerous, 1½ to 2 inches long, three-eighths to seven-sixteenths inch wide, 2 to commonly 3 seeded; seeds medium in size, round, broadly elliptical in outline, 7 to 8 mm. wide, 7 to 9 mm. long, considerably flattened, rather pale yellow with a slight greenish tinge, becoming paler with age, hilum brown.

The Manhattan variety is early to medium early, requiring from ninety to one hundred and ten days to reach maturity, the average being about one hundred to one hundred and five days. It is too small to have much forage value, and its chief use will be for an early seed crop, to which purpose it is fairly well adapted. Several yields of from 14 to 16 bushels to the acre are recorded.

This variety was named for the location of the Kansas Agricultural Experiment Station, Manhattan, Kans., where the soy bean has been under extensive experimentation for many years.

Numbers and sources of lots grown.—Agrost. No. 1295, S. P. I. No. 6333; S. P. I. No. 6333, "Gosha," Japan; S. P. I. No. 8490, grown from S. P. I. No. 6333; S. P. I. No. 9411, grown from S. P. I. No. 6333; S. P. I. No. 17277, grown from Agrost. No. 1295–2.

BUTTERBALL.

An early or medium early variety, with short, stocky, unbranched stems, dark foliage, and large yellow seeds. Plants low, 15 to 25 inches high, stems small to medium, one-eighth to one-fourth inch in size at the base, with 2 to 5 short, stubby branches near the base; leaves large, usually dark green. Pods broad, 1¼ to 2 inches long, one-half inch wide, 2 or rarely 3 seeded. The seeds are large, 7 to 8½ mm. wide, 7 to 9 mm. long, spherical, pale lemon-yellow, somewhat shiny, becoming much paler and duller with age, the hilum pale or slightly brownish.

This variety is too small to have much value except for earliness and large size of the seed. The last quality may entitle it to attention in breeding experiments. It matures in ninety-five to one hundred and ten days. Yields of 8¾ and 14⅗ bushels of seed to the acre are recorded.

The name, Butterball, was given to this variety on account of its round yellow seeds.

Numbers and sources of lots grown.—Agrost. No. 1197, "Early Japan," R. I. Agric. Expt. Station; Agrost. No. 1199, "Early Ita Name," S. P. I. No. 8422; S. P. I. No. 8422, "Early Ita Name," Japan; S. P. I. No. 17273, grown from Agrost. No. 1197–1; S. P. I. No. 17274, grown from Agrost. No. 1199–1.

AMHERST.

A rather low and stocky, well-branched variety, with large leaves and broad pods. Stems medium to stout, one-fourth to seven-sixteenths inch in thickness, 12 to 24 or 30 inches high; branches not numerous, ascending or appressed, the lower nearly as long as the stem and arising from very near its base; leaves very broad and large, medium green in color; pods very large, 1½ to 2¼ inches long, one-half inch broad, 2 or 3 seeded, borne on stem and branches almost to the ground. The seeds are large, spherical, 7 to 9 mm. in diameter, often scarcely flattened in dorsal view, deep yellow with a slight greenish tinge, becoming paler and duller with age; hilum yellow or brownish.

The time required for the Amherst variety to reach maturity varies from one hundred and five to one hundred and thirty days, the average being about one hundred and fifteen to one hundred and twenty days. It ripens a few days later than the Guelph variety, which it somewhat resembles except in being considerably smaller. It has been grown successfully in the Northern States and is reported as a fair to good yielder. Tests at Washington, D. C., have given from 5 to more than 20 bushels to the acre; the Kansas Agricultural Experiment Station reports 10 bushels, while the Kentucky station quotes yields of from 26 to 40 bushels to the acre.

It will be noted that the greenish tinge on the seeds indicates the relationship of this with the three greenish yellow varieties. Inspection of the tables will show that it lies between Yosho and Haberlandt in size and maturity, and rather nearer to the latter in both. In habit it is also very near Haberlandt.

This variety was named for the Massachusetts Agricultural Experiment Station, at Amherst, Mass., where soy beans have been cultivated for many years from specially imported seed.

Numbers and sources of lots grown.—Agrost. No. 452, grown from S. P. I. No. 4913; Agrost. No. 1170, S. P. I. No. 9408; Agrost. No. 1296, S. P. I. No. 6336; S. P. I. No. 4913, "Best White;" S. P. I. No. 5765, grown from S. P. I. No. 4913; S. P. I. No. 6336, "Bakaziro," Japan; S. P. I. No. 8494, grown from S. P. I. No. 6336; S. P. I. No. 9408, grown from S. P. I. No. 5765; S. P. I. No. 9413, grown from S. P. I. No. 6336; S. P. I. No. 12400, grown from S. P. I. No. 9408; S. P. I. No. 17275, grown from Agrost. Nos. 1170–2 and 1296–2.

HOLLYBROOK.

A fairly large, medium late variety, with long appressed or ascending branches. Stems fairly stout, one-fourth to three-eighths or one-half inch in diameter at the base, 20 to 36 inches tall, 25 to 30 inches representing the average height; branches nearly as long as the main stem, appressed or ascending; leaves large, medium green in color, pods quite thickly set on stem and branches, medium in size, 1 to 1½ inches long, three-eighths inch wide, mostly 2 seeded. Seeds medium in size, 6 to 7 mm. wide, 6 to 8 mm. long, some spherical, mostly broadly elliptical, somewhat flattened in dorso-ventral view, deep or lemon yellow, very shiny, becoming paler and duller with age; hilum usually pale brown.

For the most part this variety has been too late to mature in the Northern States, though it has been called early in Massachusetts and Rhode Island in a favorable season. It requires from one hundred and ten to one hundred and thirty-five days to reach maturity, the average being about one hundred and twenty days. Yields of 5, 9, and 20 bushels to the acre have been secured at Washington, and still better yields at some other points. This variety should make a good hay and silage crop where sown somewhat thickly. When thinly sown it has a tendency to become top-heavy and to lodge somewhat.

The Hollybrook variety was originated by Messrs. T. W. Wood & Sons, of Richmond, Va., as an early selection from Mammoth Yellow. The name "Hollybrook" was given it by them, and is the name of the seed farm on which the variety originated.

Numbers and sources of lots grown.—Agrost. No. 454, grown from S. P. I. No. 4912; Agrost. No. 976, S. P. I. No. 6556; Agrost. No. 1169, S. P. I. No. 9407; Agrost. No. 1196, S. P. I. No. 3870; Agrost. No. 1299, from Havre, France; Agrost. No. 1538, S. P. I. No. 6379; Agrost. No. 2032, "Hollybrook," Arkansas Agric. Exp. Station; S. P. I. No. 3870, China; S. P. I. No. 4912, "Common soy," Japan; S. P. I. No. 5764, grown from S. P. I. No. 4912; S. P. I. No. 6379, grown from S. P. I. No. 3870; S. P. I. No. 6556, "The most common soy," China; S. P. I. No. 9407, grown from S. P. I. No. 4912; S. P. I. No. 12399, grown from S. P. I. No. 9407; S. P. I. No. 17269, grown from Agrost. No. 976–2; S. P. I. No. 17270, grown from Agrost. No. 1169–2; S. P. I. No. 17272, grown from Agrost. No. 1538–1; S. P. I. No. 17276, grown from Agrost. No. 1299–1 and 1299–2; S. P. I. No. 17278, grown from Agrost. No. 2032.

MAMMOTH.

The Mammoth is the best known and most widely cultivated variety in the Southern States. It has also been sold to a considerable extent in the North, mostly because of the splendid growth it makes, but it has never given satisfaction there because of its lateness. It has been a commercial variety in this country for a great many years, but its origin is not known. None of the varieties yet imported by this Department has proved to be exactly the same form. The Hollybrook is the most closely related, but differs in its considerably lower growth and in being a little earlier also. The Mammoth is the largest variety here discussed, though not quite so tall as the Riceland and Hankow.

The main stems are from one-fourth to more than one-half inch in diameter at the base, from 24 or 30 to fully 48 inches in height, well branched from quite near the base, with long, ascending branches, the lower ones from 1½ to 2 feet long, the leaves very large, usually rather more pointed than in the other large-leaved varieties, medium to dark in color; pods 1 to 1½ inches long, three-eighths to seven-sixteenths inch wide, 2 or often 3 seeded, scattered over the stem and long branches; the seeds are medium in size, 6 to 6½ mm. wide, 6 to 7½ or 8 mm. long, spherical or broadly oblong in outline, somewhat flattened, bright lemon-yellow, shining, becoming paler and duller with age; hilum usually pale brown.

The time required to reach maturity varies from one hundred and ten to one hundred and forty days, the average being one hundred and twenty and one hundred and thirty days. The yields of 17 plats at Washington varied between 4⅔ and 15 bushels to the acre, with an average of 9⅓ bushels.

The name, Mammoth, is very suitable for this variety, and is coming into use for it in the agricultural press and by some seedsmen.

Numbers and sources of lots grown.—Agrost. No. 1195, "Yellow," S. P. I. No. 4285, Virginia; Agrost. No. 1300, "Late," F. Barteldes & Co.; Agrost. No. 1305, T. W. Wood & Sons; Agrost. No. 1307, "Southern," T. W. Wood & Sons; Agrost. No. 1308, Iowa Seed Co.; Agrost. No. 1309, Johnson & Stokes; Agrost. No. 1310, Plant Seed Co.; Agrost. No. 1311, C. J. McCullough; Agrost. No. 1314, "Late Yellow," Peter Henderson & Co.; Agrost. No. 1315, Northrup, King & Co.; Agrost. No. 1465, "Yellow," Breck & Sons; Agrost. No. 1466, "Yellow," Texas Seed and Floral Co.; Agrost. No. 1472, "Southern," J. M. Thorburn & Co.; Agrost. No. 1477, Hammond Seed Co.; Agrost.

No. 1976, union of seven of above serial numbers; Agrost. No. 1977, union of seven of above serial numbers; S. P. I. No. 4285, "Yellow," T. W. Wood & Sons; S. P. I. No. 17280, grown from Agrost. Nos. 1976 and 1977.

LIST OF SYNONYMS.

The following is a list of the names under which soy beans have been received from experiment stations, seedsmen, and growers in the United States. It includes all the important names under which varieties have been sold or written about in the agricultural press, seed catalogues, and experiment station bulletins. After each such name is given the name under which the variety is described in this bulletin.

Adzuki	Ito San.
Black	Buckshot.
Brown Eda Mame	Eda.
Crossbred No. 6	Ogemaw.
Early Black	Buckshot.
Early Green	Guelph.
Early Japan	Butterball.
Early White	Ito San.
Early Yellow	Ito San.
Extra Early Black	Buckshot.
Green	Guelph.
Green Samarow	Samarow.
Hollybrook	Hollybrook.
Ito San	Ito San.
Japanese No. 15	Kingston.
Kaiyuski Daizu	Ito San.
Kiyusuki Daidzu	Ito San.
Kysuki	Ito San.
Large Black	Buckshot.
Late Yellow	Mammoth.
Mammoth Yellow	Mammoth.
Medium Black	Buckshot.
Medium Early Black	Buckshot.
Medium Early Green	Guelph.
Medium Green	Guelph.
Ogema	Ogemaw.
Southern	Mammoth.
Yellow	Mammoth.
Yellow Eda Mame	Ito San.

DISTRIBUTION NUMBERS.

The following are the serial numbers under which soy beans were distributed by the former Division of Agrostology, with the name of the variety to which each has been referred:

452. Amherst.
454. Hollybrook.
468. Tokyo.
658. Ito San.
696. Tokyo.
912. Guelph.
964. Riceland.
969. Guelph.
972. Hankow.
976. Hollybrook.
1169. Hollybrook.
1170. Amherst.
1171. Tokyo.
1183. Ito San.
1184. Buckshot.
1185. Eda.
1186. Ito San.
1187. Ito San.
1188. Kingston.
1189. Ito San.
1192. Ito San.
1193. Ebony.
1194. Haberlandt.
1195. Mammoth.
1196. Hollybrook.
1197. Butterball.
1198. Tokyo.
1199. Butterball.
1200. Tokyo.
1292. Buckshot.
1293. Flat King.
1294. Ito San.
1295. Manhattan.
1296. Amherst.
1297. Yosho.
1298. Tokyo.
1299. Hollybrook.
1300. Mammoth.
1301. Buckshot.
1302. Samarow.
1303. Buckshot.
1304. Buckshot.
1305. Mammoth.
1306. Guelph.
1307. Mammoth.
1308. Mammoth.
1309. Mammoth.
1310. Mammoth.
1311. Mammoth.
1312. Guelph.
1313. Ito San.
1314. Mammoth.
1315. Mammoth.
1316. Ito San.

1464. Guelph.
1465. Mammoth.
1466. Mammoth.
1467. Guelph.
1468. Ito San.
1469. Guelph.
1470. Samarow.
1471. Buckshot.
1472. Mammoth.
1473. Guelph.
1474. Buckshot.
1475. Ito San.
1476. Guelph.
1477. Mammoth.
1478. Ito San.
1536. Nuttall.
1538. Hollybrook.
1539. Haberlandt.
1540. Haberlandt.
1541. Ebony.
1542. Brownie and Baird.
1764. Guelph.
1765. Ito San.
1971. Guelph.
1972. Samarow.
1973. Ito San.
1974. Ito San.
1975. Ito San.
1976. Mammoth.
1977. Mammoth.
1978. Buckshot.
1979. Buckshot.
1980. Ebony.
1992. Ogemaw.
2031. Ogemaw.
2032. Hollybrook.
2033. Buckshot.

The following is a list of the serial numbers under which soy beans have been distributed by the Office of Seed and Plant Introduction and Distribution, with the name of the variety to which each is referred in this bulletin. Several S. P. I. numbers representing soy beans not studied by the writer are not included in the list.

3870. Hollybrook.
4285. Mammoth.
4912. Hollybrook.
4913. Amherst.
4914. Tokyo.
5764. Hollybrook.
5765. Amherst.
5766. Tokyo.
6312. Flat King.
6314. Yosho.
6326. Ito San.
6333. Manhattan.
6334. Buckshot.
6335. Tokyo.
6336. Amherst.
6379. Hollybrook.
6386. Ebony.
6396. Haberlandt.
6397. Haberlandt.
6414. Brownie and Baird.
6416. Nuttall.
6556. Hollybrook.
6558. Guelph.
6559. Hankow.
6560. Riceland.
8422. Butterball.
8423. Tokyo.
8424. Tokyo.
8489. Yosho.
8490. Manhattan.
8491. Buckshot.
8492. Ebony.
8493. Haberlandt.
8494. Amherst.
8495. Haberlandt.
8496. Nuttall.
8497. Flat King.
9344. (Probably Hankow.)
9407. Hollybrook.
9408. Amherst.
9409. Tokyo.
9410. Flat King.
9411. Manhattan.
9412. Buckshot.
9413. Amherst.
9414. Ebony.
9415. Haberlandt.
9416. Haberlandt.
9417. Brownie and Baird.
9418. Nuttall.
11179. Buckshot.
12399. Hollybrook.
12400. Amherst.
13502. Ogemaw.
13503. Guelph.
16790. (Probably Riceland.)
17251. Buckshot.
17252. Flat King.
17253. Nuttall.
17254. Ebony.
17255. Kingston.
17256. Brownie and Baird.
17257. Eda.
17258. Ogemaw.
17259. Ogemaw.
17260. Samarow.
17261. Guelph.
17262. Yosho.
17263. Haberlandt.
17264. Tokyo.
17265. Tokyo.
17266. Tokyo.
17267. Tokyo.
17268. Ito San.
17269. Hollybrook.
17270. Hollybrook.
17271. Haberlandt.
17272. Hollybrook.
17273. Butterball.
17274. Butterball.
17275. Amherst.
17276. Hollybrook.
17277. Manhattan.
17278. Hollybrook.
17280. Mammoth.
17852. Meyer.

PLATES.

28

29

DESCRIPTION OF PLATES.

Plate I. *Frontispiece.* Seeds of all varieties of soy beans in natural sizes and colors. Black-seeded group: 1.—Buckshot. 2.—Nuttall. 3.—Kingston. 4.—Ebony. 5.—Flat King. 6.—Riceland; one seed washed, one with bloom. 6*a*.—A larger undetermined soy bean from Italy. Brown-seeded group: 7.—Ogemaw. 8.—Eda, showing different shades of color. 9.—Baird and Brownie (the two left-hand seeds, Baird; the right-hand seed, Brownie). Mottled-seeded group: 10.—Meyer. 11.—Hankow; one seed washed, one with bloom, one in dorsal view. Green-seeded group: 12.—Samarow. 13.—Guelph. 14.—Yosho; one lateral view, one ventral view showing hilum. 15.—Haberlandt; one lateral view, one ventral view showing hilum. 16.—Tokyo; one lateral view, one ventral view showing hilum. Yellow-seeded group: 17.—Ito San. 18.—Manhattan. 19.—Butterball. 20.—Amherst. 21.—Hollybrook. 22.—Mammoth.

Plate II. Seeds and pods of the black-seeded group. Seeds of different sizes in lateral and ventral (or hilum) view, and pods in lateral view: Buckshot, Nuttall, Kingston, Ebony, Flat King, Riceland, and a larger undetermined soy bean from Italy.

Plate III. Seeds and pods of the brown-seeded and mottled-seeded groups. Seeds of different sizes in lateral and ventral (or hilum) view, and pods in lateral view: Ogemaw, Eda, Baird and Brownie (the four right-hand seeds and the upper pod, Brownie; the four left-hand seeds and the lower pod, Baird), Meyer, Hankow.

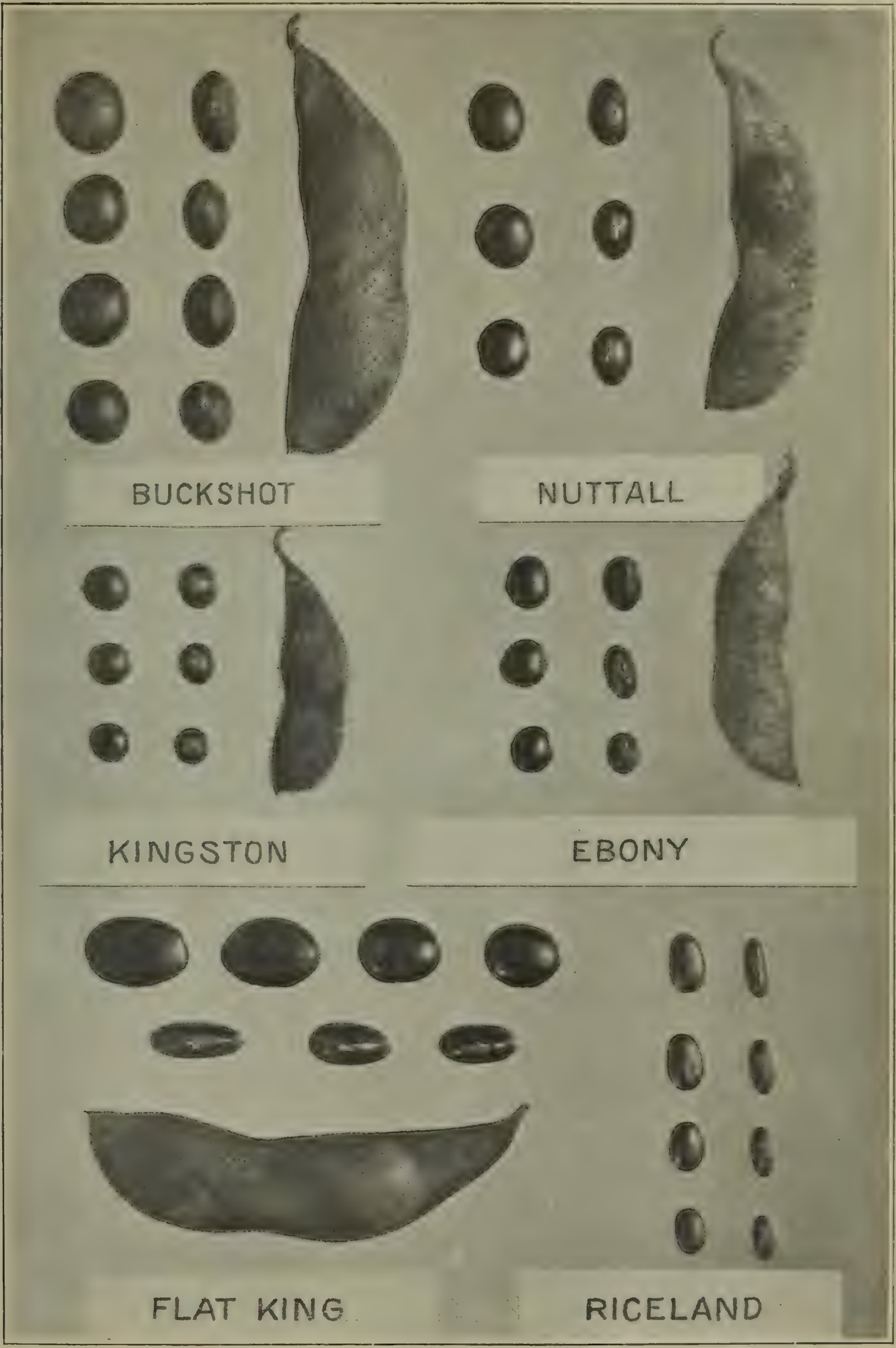
Plate IV. Seeds and pods of the green-seeded and greenish-yellow-seeded groups. Seeds of different sizes in lateral and ventral (or hilum) view, and pods in lateral view: Samarow, Guelph, Yosho, Haberlandt, Tokyo.

Plate V. Seeds and pods of the yellow-seeded group. Seeds of different sizes in lateral and ventral (or hilum) view, and pods in lateral view: Ito San, Manhattan, Butterball, Amherst, Hollybrook, Mammoth.

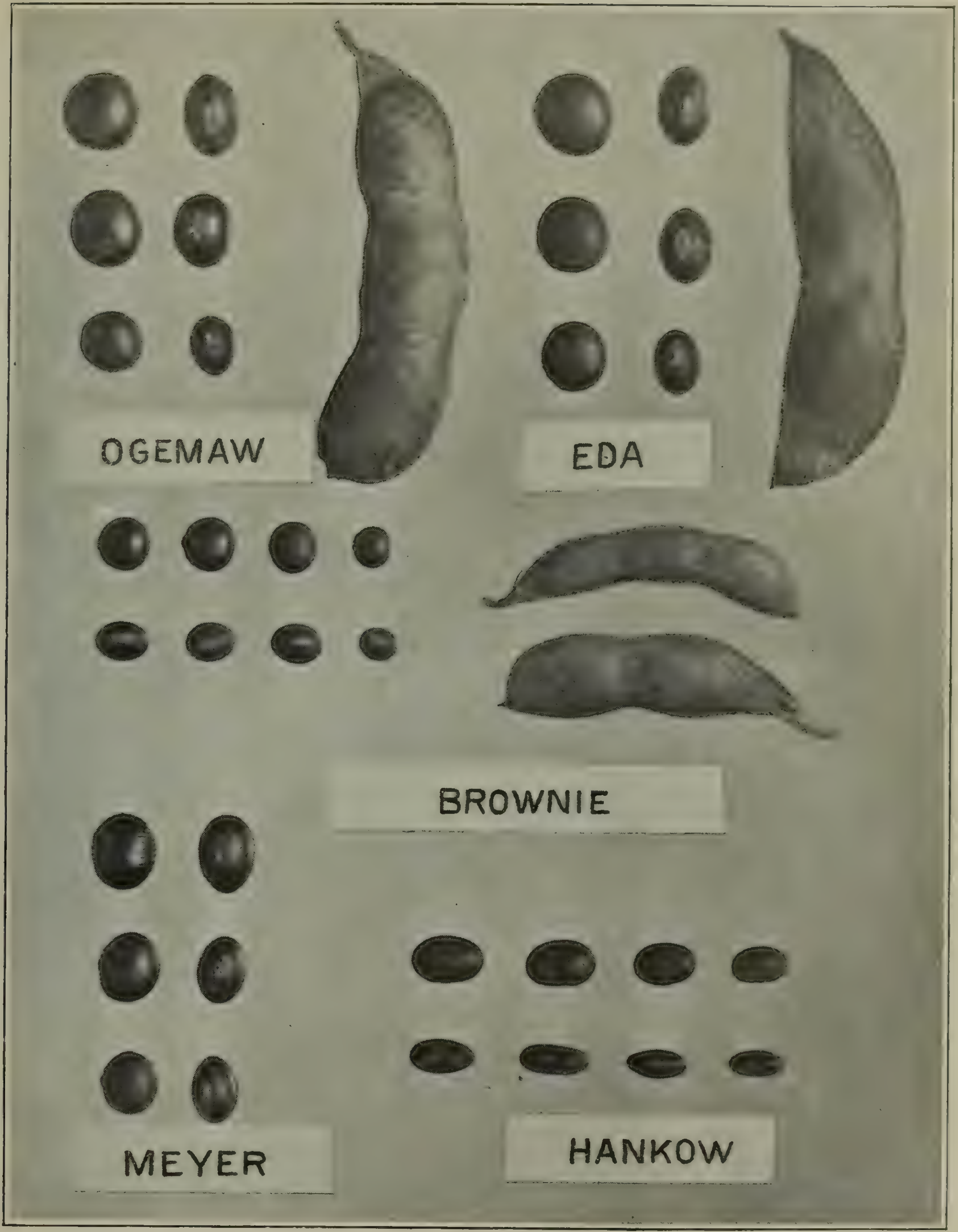
98

30

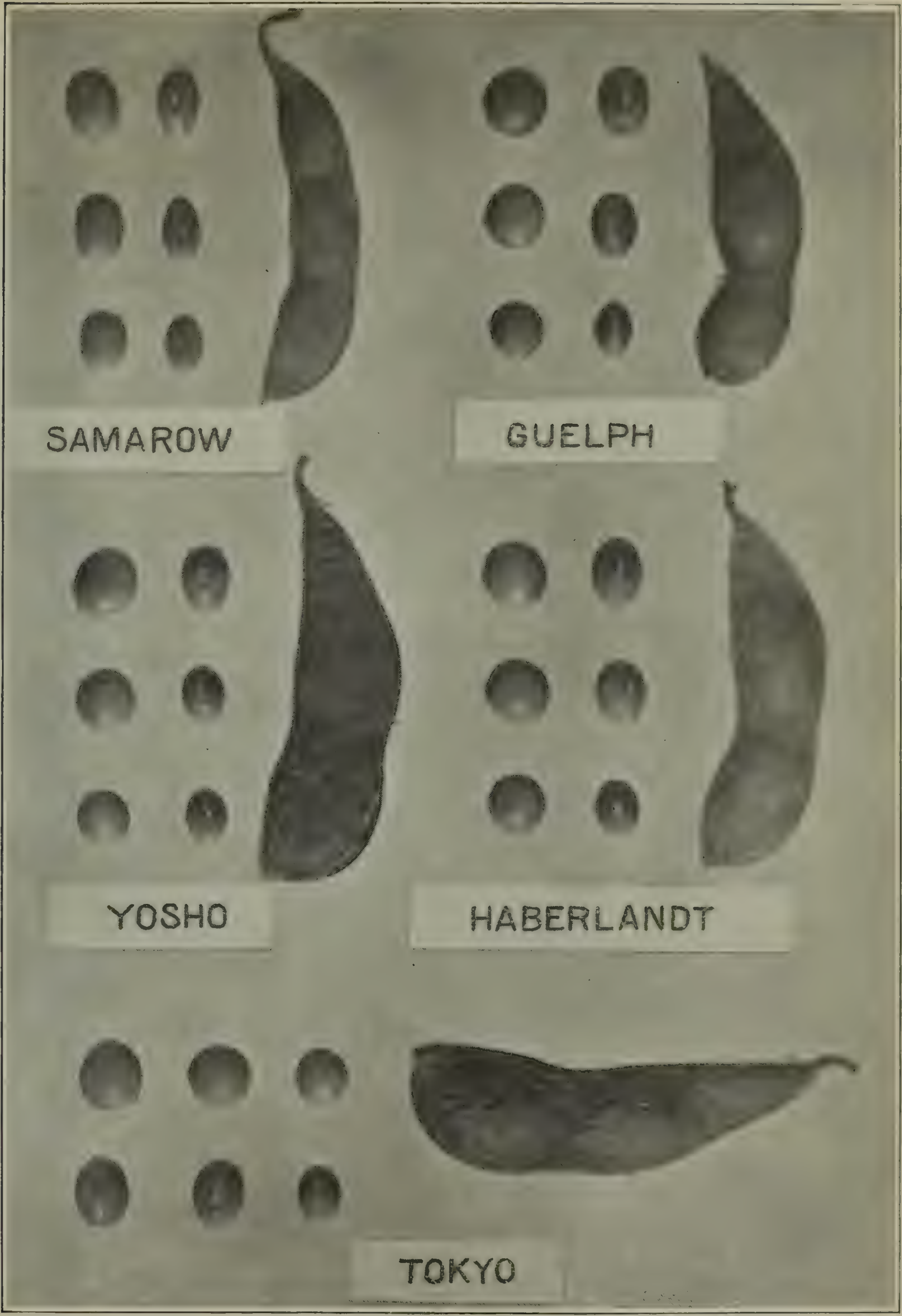
()


BUCKSHOT
NUTTALL
KINGSTON
EBONY
FLAT KING
RICELAND

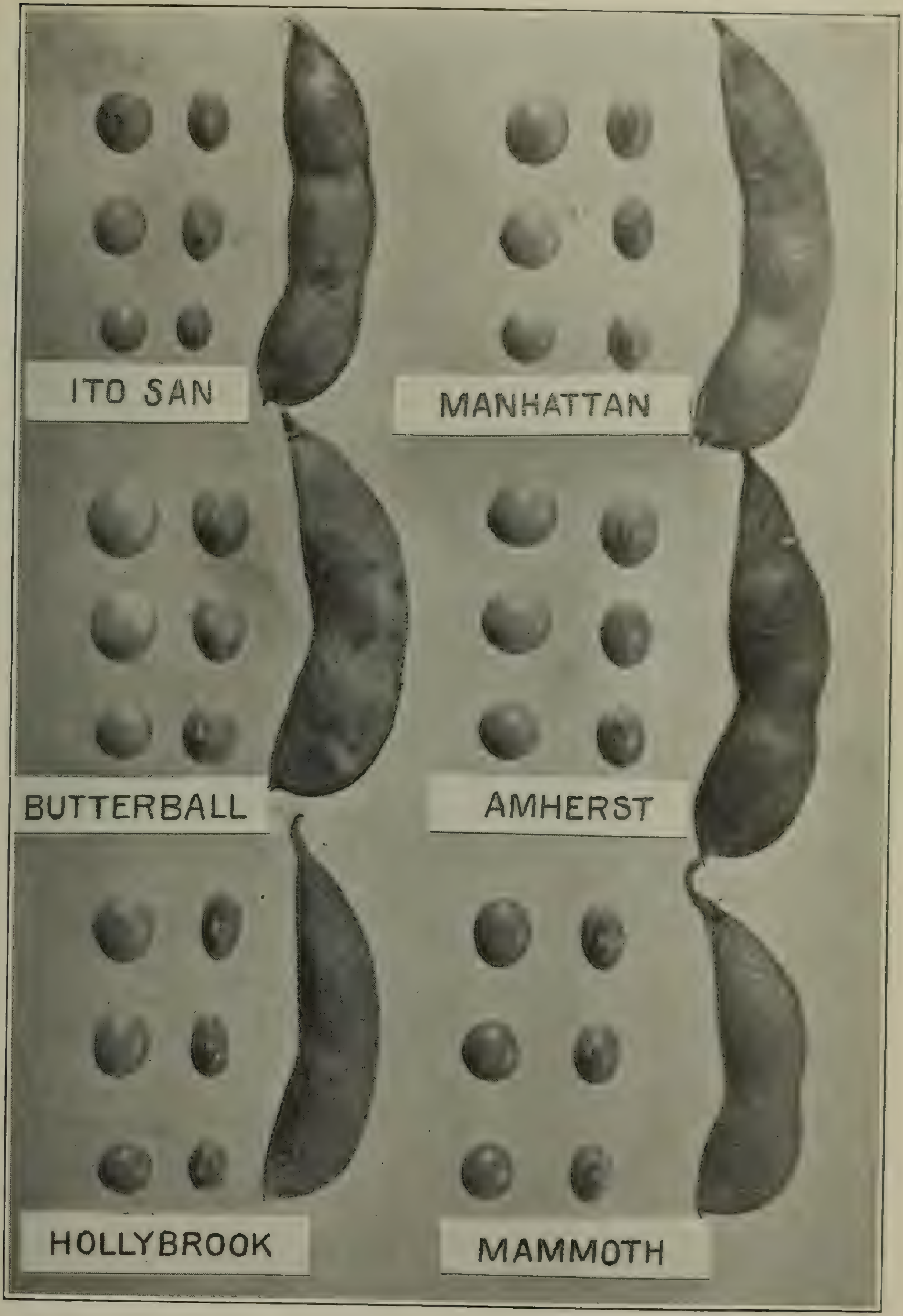
SEEDS AND PODS OF THE BLACK-SEEDED GROUP.


OGEMAW
EDA
BROWNIE
MEYER
HANKOW

SEEDS AND PODS OF THE BROWN-SEEDED AND MOTTLED-SEEDED GROUPS.


SAMAROW
GUELPH
YOSHO
HABERLANDT
TOKYO

SEEDS AND PODS OF THE GREEN-SEEDED AND GREENISH-YELLOW-SEEDED GROUPS.


ITO SAN
MANHATTAN
BUTTERBALL
AMHERST
HOLLYBROOK
MAMMOTH

SEEDS AND PODS OF THE YELLOW-SEEDED GROUP.

U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 99.
B. T. GALLOWAY, *Chief of Bureau.*

A QUICK METHOD FOR THE DETERMINATION OF MOISTURE IN GRAIN.

BY

EDGAR BROWN,
Botanist in Charge of the Seed Laboratory.
AND
J. W. T. DUVEL,
Assistant in the Seed Laboratory.

Issued January 31, 1907.

239413
13. 1. 30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1907.

BUREAU OF PLANT INDUSTRY.

Pathologist and Physiologist, and Chief of Bureau, Beverly T. Galloway.
Pathologist and Physiologist, and Assistant Chief of Bureau, Albert F. Woods.
Laboratory of Plant Pathology, Erwin F. Smith, Pathologist in Charge.
Investigations of Diseases of Fruits, Merton B. Waite, Pathologist in Charge.
Plant Breeding Investigations, Herbert J. Webber, Physiologist in Charge.
Plant Life History Investigations, Walter T. Swingle, Physiologist in Charge.
Soil Bacteriology and Water Purification Investigations, Karl F. Kellerman, Physiologist in Charge.
Bionomic Investigations of Tropical and Subtropical Plants, Orator F. Cook, Bionomist in Charge.
Drug and Poisonous Plant Investigations and Tea Culture Investigations, Rodney H. True, Physiologist in Charge.
Physical Laboratory, Lyman J. Briggs, Physicist in Charge.
Taxonomic Investigations, Frederick V. Coville, Botanist in Charge.
Farm Management Investigations, William J. Spillman, Agriculturist in Charge.
Grain Investigations, Mark A. Carleton, Cerealist in Charge.
Arlington Experimental Farm, Lee C. Corbett, Horticulturist in Charge.
Sugar-Beet Investigations, Charles O. Townsend, Pathologist in Charge.
Western Agricultural Extension, Carl S. Scofield, Agriculturist in Charge.
Dry Land Agriculture, E. Channing Chilcott, Agriculturist in Charge.
Pomological Collections, Gustavus B. Brackett, Pomologist in Charge.
Field Investigations in Pomology, William A. Taylor and G. Harold Powell, Pomologists in Charge.
Experimental Gardens and Grounds, Edward M. Byrnes, Superintendent.
Seed and Plant Introduction and Distribution, David Fairchild, Agricultural Explorer in Charge.
Seed Laboratory, Edgar Brown, Botanist in Charge.
Grain Standardization, John D. Shanahan, Expert in Charge.
Mississippi Valley Laboratory, St. Louis, Mo., Hermann von Schrenk, Expert in Charge.
Subtropical Laboratory and Garden, Miami, Fla., Ernst A. Bessey, Pathologist in Charge.
Plant Introduction Garden, Chico, Cal., Palemon H. Dorsett, Pathologist in Charge.
Cotton Culture Farms, Seaman A. Knapp, Lake Charles, La., Special Agent in Charge.

Editor, J. E. Rockwell.
Chief Clerk, James E. Jones.

SEED LABORATORY.

SCIENTIFIC STAFF.

Edgar Brown, *Botanist in Charge.*
J. W. T. Duvel, *Assistant.*
F. H. Hillman, *Assistant Botanist.*
W. L. Goss, *Assistant.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., November 3, 1906.

Sir: I have the honor to transmit herewith a manuscript entitled "A Quick Method for the Determination of Moisture in Grain," and to recommend that it be published as Bulletin No. 99 of the series of this Bureau.

By means of the method and apparatus described it is possible to make complete moisture determinations of grain in from 20 to 25 minutes. This makes it practicable in commercial work to include a definite statement of the moisture content among the factors determining quality.

This paper was prepared by Mr. Edgar Brown, botanist in charge of the Seed Laboratory, and Dr. J. W. T. Duvel, assistant in the Seed Laboratory. The illustrations which accompany it are necessary to a full understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

	Page.
Quality of export corn	7
Causes of deterioration	7
The percentage basis for moisture determinations	8
Description of a method for the rapid determination of moisture	9
Preparation of samples for moisture determination	10
Taking the bulk sample	10
Taking the sample for the moisture test	10
Size of sample for the moisture test	11
Weighing the sample for the moisture test	11
Grinding the grain unnecessary	12
Oil for the moisture test	12
Quality required	12
Quantity required	13
Description of the apparatus	13
The evaporating chamber	13
The condenser	18
The stand supporting the evaporating chamber and condenser	18
The distillation flasks	19
The thermometers	20
The condenser tubes	20
The graduated cylinders for collecting and measuring the water	20
Comparison of results with determinations made in a water oven	21
Variations in duplicate tests	22
Summary	23

99

ILLUSTRATIONS.

Page.
Fig. 1. Balance for weighing grain samples 9
2. Aluminum weighing pan for transferring grain samples to the distillation flasks 11
3. Plan of front of apparatus for moisture determination 14
4. Plan of back of apparatus for moisture determination 15
5. Plan of end of apparatus for moisture determination 16
6. Front view of apparatus for moisture determination 17
7. Back view of apparatus for moisture determination 17
8. End view of apparatus for moisture determination 18
9. Interior arrangement of the compartments of the evaporating chamber, showing the position of the triangle over the gauze 19
10. Distillation flask 19
11. Condenser tube 20
12. Graduated cylinders for measuring the water expelled from the grain 21

B. P. I.—240.

A QUICK METHOD FOR THE DETERMINATION OF MOISTURE IN GRAIN.[a]

QUALITY OF EXPORT CORN.

During the past few years the commercial grading of corn has been a matter of much controversy, both in the United States and in Europe. Complaints of the poor condition of corn on arrival at European ports have been constantly increasing, corn inspected at American ports as No. 2, or "prime sail," having proved in many cases unfit for feeding purposes when discharged at foreign ports. This uncertainty as to quality has already led European buyers to purchase largely from other corn-growing countries, and unless the quality of corn exported from the United States is improved our foreign trade must inevitably suffer. Last year the total quantity of corn imported into France (general trade) was, in round numbers, twelve and three-fourths million bushels, of which the United States furnished only 20.9 per cent, or approximately two and two-thirds million bushels, while Argentina alone supplied 64.4 per cent, or approximately eight and one-fourth million bushels.

CAUSES OF DETERIORATION.

The principal cause of the deterioration of corn during transit or in storage is an excessive amount of moisture. Corn as it is harvested in the autumn ordinarily contains from 20 per cent to 35 per cent of water, depending on the season and the relative time of harvesting. Much of the corn as it comes from the fields goes directly into the small elevators thruout the corn-growing States, to be transferred later to the large elevators or storage bins at the grain centers. Owing to the cold weather usually prevalent at this season of the year, corn may be stored or exported without much danger of deterioration, even tho the water content is relatively high, but with a slight rise in temperature it will begin to sweat, after which fermentation soon sets in, resulting in moldy and damaged grain.

---

[a] Application has been made for a patent on the apparatus described in this bulletin, in order that it may be used or manufactured by any person in the United States without the payment of royalty.

With the present system of grain inspection, when hundreds of cars must be inspected daily, and the water content of the corn is determined only by feeling the corn with the hand or by biting the kernels, any degree of accuracy is next to impossible. Most of this work is done in the cars on the track and sometimes when the mercury has gone below the zero mark.

THE PERCENTAGE BASIS FOR MOISTURE DETERMINATIONS.

There seems to be a growing demand among grain men and inspection departments for a more definite and uniform system of grading, which is taking the form of an agitation for uniform rules for grades. Any system of uniform grading to be effective must be based on a percentage statement of the various factors which go to make up the quality and condition of any particular lot of grain in order to insure uniformity of application. With this in view, a considerable amount of preliminary work has been done for several years in the Bureau of Plant Industry, which will later aid in formulating rules to place the grading of grain on a basis which will permit stating the elements of condition and quality in definite terms.

Members of boards of trade and chambers of commerce, as well as most grain inspectors, have been much in doubt as to the practicability of incorporating in their rules a percentage statement of moisture in grain, and with the methods commonly employed for making moisture determinations the percentage system is not suitable to the present condition of the grain trade, save, perhaps, in a few special cases. Heretofore the minimum time required to make a moisture determination of a sample of grain was from six to eight hours, and this was accomplished by drying a carefully weighed ground sample in a glycerin oven or in a vacuum at a temperature of 105° or 108° C. If the drying be done in an ordinary water oven, such as is commonly used, the time must be extended to from sixteen to twenty hours. To each of these periods must be added the time occupied in grinding and weighing the sample preparatory to drying, and likewise the time required for the samples to cool in the desiccator before the final weighing. If whole kernels are used instead of a ground sample, the time required by the process at present in use must be extended to from sixty to ninety-six hours.

But, disregarding the time factor, the method outlined is not applicable to commercial corn containing a relatively large percentage of water. Practically all of the machines available for grinding samples of grain for analysis are of the "burr" type, and during the grinding the temperature of the grain is increased to such an extent that from 0.5 per cent to 1.5 per cent of moisture is lost in the process of grinding, unless the corn has been well cured and dried, in which case a moisture determination is not needed.

It has therefore become necessary to devise some suitable method and apparatus for determining the amount of water in corn and other grains before any hope of placing the grading of grain on a percentage basis can be entertained seriously at any of our large grain centers. It is hoped that the method described in the following pages, which is applicable to the testing of wheat and other grains as well as corn, will be sufficiently rapid and easy to make it of practical value to the grain trade, and possibly to other industries.

DESCRIPTION OF A METHOD FOR THE RAPID DETERMINATION OF MOISTURE.

The fundamental principle[a] on which this method of moisture determination is based consists in heating whole grains in oil to a temperature considerably above that of boiling water and thus driving out the water, which is afterwards condensed and measured in a graduated flask. With this method it is possible to determine the percentage of water in a sample of corn in from twenty to twenty-five minutes.

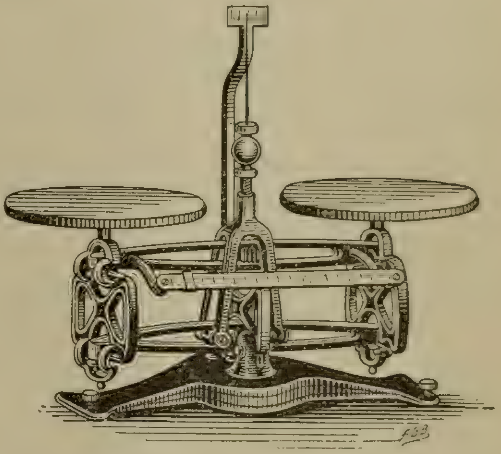


FIG. 1.—Balance for weighing grain samples.

One hundred cubic centimeters of a good grade of hydrocarbon oil are measured and poured into a glass distillation flask (see fig. 10). One hundred grams of corn are weighed on a torsion balance similar to the one shown in figure 1, the corn being emptied at once into the flask containing the oil. The neck of the flask is closed with a good rubber stopper carrying a thermometer, the bulb of which should extend well into the mixture of oil and corn. The side of the flask is then connected with a condenser by means of a second rubber stopper. With a strong gas burner the corn in the oil bath is then heated until the thermometer registers 190° C. (374° F.), at which time the flame is extinguished. The time required for the temperature to reach 190° C. will be from ten to fifteen minutes, depending on the amount of water in the corn and on the volume of the flame. Eight or ten minutes after the flame has been removed the water will have ceased dropping from the condenser, and the number of cubic centimeters of water contained in the graduated cylinder beneath the condenser tube can be ascertained. This is the water actually removed from the corn and represents the percentage of moisture originally in the sample, each cubic centimeter of water representing 1 per cent when a 100-gram sample is used. By the use of this method, together with the special apparatus described in this bulletin, a person familiar with laboratory work and an assistant should be able to make at least 200 moisture determinations in a day of eight hours.

---

[a] This principle has already been described by Dr. J. F. Hoffmann in Zeitschrift für Angewandte Chemie, Berlin, 1902, p. 1193, and in the Grain Dealers' Journal, Chicago, May, 1906, p. 526. However, the apparatus used by Hoffmann and likewise the details of the method described by him have proved unsuitable where large numbers of samples are to be analyzed. Consequently, in August, 1905, experiments were begun to simplify the Hoffmann method and to devise an apparatus which would prove practical for laboratories handling a large number of samples of grain.

PREPARATION OF SAMPLES FOR MOISTURE DETERMINATION.

TAKING THE BULK SAMPLE.

Care in drawing the bulk sample from the car, cargo, conveyer, etc., is of the utmost importance and can not be too strongly emphasized, for unless this part of the work is properly done the true percentage of moisture in the grain can not be determined.

The samples should be taken in such a way as to represent as nearly as possible the condition of the entire lot of grain under consideration, and in this respect the method herein described does not differ from any other system of inspection. The number of samples to be drawn from different parts of the bulk will depend upon the quantity and quality of the grain to be past upon. The larger samples so drawn may be analyzed separately or they may be mixt together to form one composite sample representing the entire bulk and the smaller samples for the individual moisture determinations taken from this mixture, as the conditions may warrant. If the bulk of corn being examined is of uniform quality, a moisture determination of the composite sample will suffice; but if the bulk lacks uniformity, and particularly if of a low grade, the samples taken from different parts of the grain under consideration or at different times during the "running" should be analyzed separately. At the same time the amount of grain represented by each sample should be estimated. But whatever samples are intended for moisture determination must be put at once into a suitable air-tight container in order to prevent any drying of the grain on being exposed to the air; otherwise the amount of moisture actually present can not be accurately determined. This precaution is particularly important in the case of samples drawn from any bulk lot of grain which has begun to sweat.

TAKING THE SAMPLE FOR THE MOISTURE TEST.

The accuracy of any method of determining moisture depends primarily on the small sample used for the test being thoroly representative of the bulk sample. In order that the small sample may be representative, the bulk sample should be thoroly mixt and small portions taken from different parts of it. The greatest accuracy can be secured thru the use of some form of mechanical mixer and sampler, and the one shown on pages 12 and 13 of Circular 34, Revised, Office of Experiment Stations, modified so as to be adapted for larger grain, is recommended.

SIZE OF SAMPLE FOR THE MOISTURE TEST.

The size of the sample to be taken for the individual moisture test may be varied, but experience has shown that 100 grams of whole kernels give the most satisfactory results, which quantity has therefore been established as the standard for the method and apparatus for testing corn herein described. This is a sufficiently large quantity to insure the securing, without difficulty, of a representative sample. Moreover, when samples containing 100 grams are used, every cubic centimeter of water expelled from the grain represents 1 per cent of moisture, and the readings in the graduated cylinders are in percentages as well as in volume, thereby reducing the chances of error to a minimum.

WEIGHING THE SAMPLE FOR THE MOISTURE TEST.

In making moisture determinations according to the method outlined in the foregoing pages, the use of delicate analytical balances is obviated. An ordinary torsion balance similar to the one shown as figure 1, which is sensitive to one-thirtieth of a gram and can be purchased for about $15, will serve every purpose. A more delicate balance is entirely unnecessary when it is remembered that one kernel of corn weighs approximately one-third of a gram. The scale pans are 6 inches in diameter, and the side beam shows 5 grams, graduated in one hundred divisions, each one-twentieth of a gram, and the total capacity of the balances is 2 pounds, or 907 grams. Balances of this kind are easily operated, and the time consumed in the weighing need not be longer than that required for the pharmacist to weigh out the prepared drugs for his medicines.

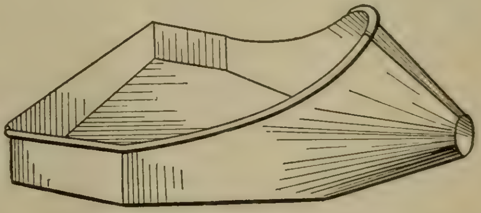


FIG. 2.—Aluminum weighing pan for transferring grain samples to the distillation flasks.

A specially constructed scale pan, such as is shown as figure 2, should be secured to facilitate the transferring of the weighed samples to the distillation flasks, the opening in the end of the scoop being of the same size as the neck of the flasks—1 inch. If made of light material, preferably aluminum, a scoop of this kind need not weigh more than 50 or 75 grams and can be substituted for one of the scale pans or used with a counterpoise. The scoop should be about 4 inches wide.

GRINDING THE GRAIN UNNECESSARY.

The whole kernels are used for making the moisture determination, thus doing away with the preliminary grinding of the samples; in fact, the method described is not applicable, without some modification, to samples of ground grain. Ground samples have a tendency to cake in the bottom of the flask and prevent a free circulation of the oil, with a corresponding variation in the temperature at different points in the sample of meal, and the results obtained are not reliable. Moreover, the grinding of samples for the determination of moisture in commercial grain is always to be avoided. Grain of this character generally contains a high percentage of moisture, and with the "burr" type of mill usually used for grinding samples of this kind the friction developed during the grinding causes a rise in temperature and a corresponding loss of moisture. This loss of moisture increases as the water content of the grain increases, and in samples of grain which have begun to sweat this loss is frequently as much as 1½ per cent.

OIL FOR THE MOISTURE TEST.

QUALITY REQUIRED.

In securing an oil suitable for the bath in which the corn is to be heated, five primary factors must be taken into consideration:

(1) The oil must be free from water.

(2) It must be an oil having a comparatively low viscosity, so that it will run freely at ordinary room temperature.

(3) The flash point must be sufficiently high to avoid danger of an explosion or fire.

(4) The saponification value should be zero.

(5) The oil must be cheap.

Experiments have demonstrated that any of the pure hydrocarbon oils showing a composition within the range of the two samples indicated below will give satisfactory results:

	No. 1.	No. 2.
Specific gravity at 15.5° C	0. 9095	0. 8957
Viscosity at 20° C. (Engler)	19. 2	6. 2
Flash point (open cup) degrees centigrade	205	175
Fire point (open cup) do	245	210
Saponification value	None.	None.

An oil similar to sample No. 1 is to be preferred to sample No. 2, owing to the difference in the flash point, altho the latter may be used with safety if the necessary precautions are taken to prevent the temperature running too high; however, an oil with a flash point as low as 175° C. in an open cup is not to be recommended for general use. An oil with a flash point of from 200° to 205° C. (open cup) and a viscosity of 10 or 15 at 20° C. (Engler) is more desirable. Oils of this character are found among many grades of lubricating oils, especially those known as "engine oils," and can be purchased in barrel lots for about 12½ or 15 cents a gallon.

As the moisture is liberated from the grain the foaming of the oil will be quite pronounced, and the flask must be sufficiently large to prevent the foaming oil from being carried over into the condenser tube. The foaming can be greatly reduced by the addition of from 15 to 20 per cent of paraffin, but this is usually unnecessary.

QUANTITY REQUIRED.

The quantity of the oil in the distillation flask admits of a wide variation, it being only necessary to have such a quantity of oil that all of the grain used for the test will be immersed. One hundred grams of corn require approximately 100 cubic centimeters of oil, while if only 50 grams of grain are used the quantity of oil can be reduced. The quantity of oil used, however, is not an important factor, inasmuch as the greater part of it can be recovered by emptying the contents of the flask into a colander at the close of the test and allowing the oil to drain off. The oil so recovered can be used again with equally as good results as with fresh oil. But even if the oil is not used a second time, 1 gallon, costing 12½ or 15 cents, is sufficient for forty tests.

DESCRIPTION OF THE APPARATUS.

In devising the apparatus for making moisture determinations in accordance with the method outlined in these pages, the principal aim has been to secure an apparatus suitable for laboratories engaged in determining the percentage of water in samples of commercial grain. The following description and the accompanying illustrations (figs. 3, 4, 5, 6, 7, and 8) show the detailed construction of the apparatus.

THE EVAPORATING CHAMBER.

For the want of a better term the name "evaporating chamber" has been applied to that part of the apparatus in which the samples of corn immersed in the oil are heated. (See figs. 4 and 5.) The evaporating chamber (*B*) is made of a good quality of galvanized iron and is divided into six compartments, as shown in figure 4.

A six-compartment chamber is here described, it being the best for ordinary work; however, the apparatus can be made with a single compartment or with a dozen or more, if so desired. Each of the compartments is lined thruout with heavy asbestos. In addition to the asbestos lining the front of the chamber—the wall next to the condenser—is covered with heavy asbestos on the outside.

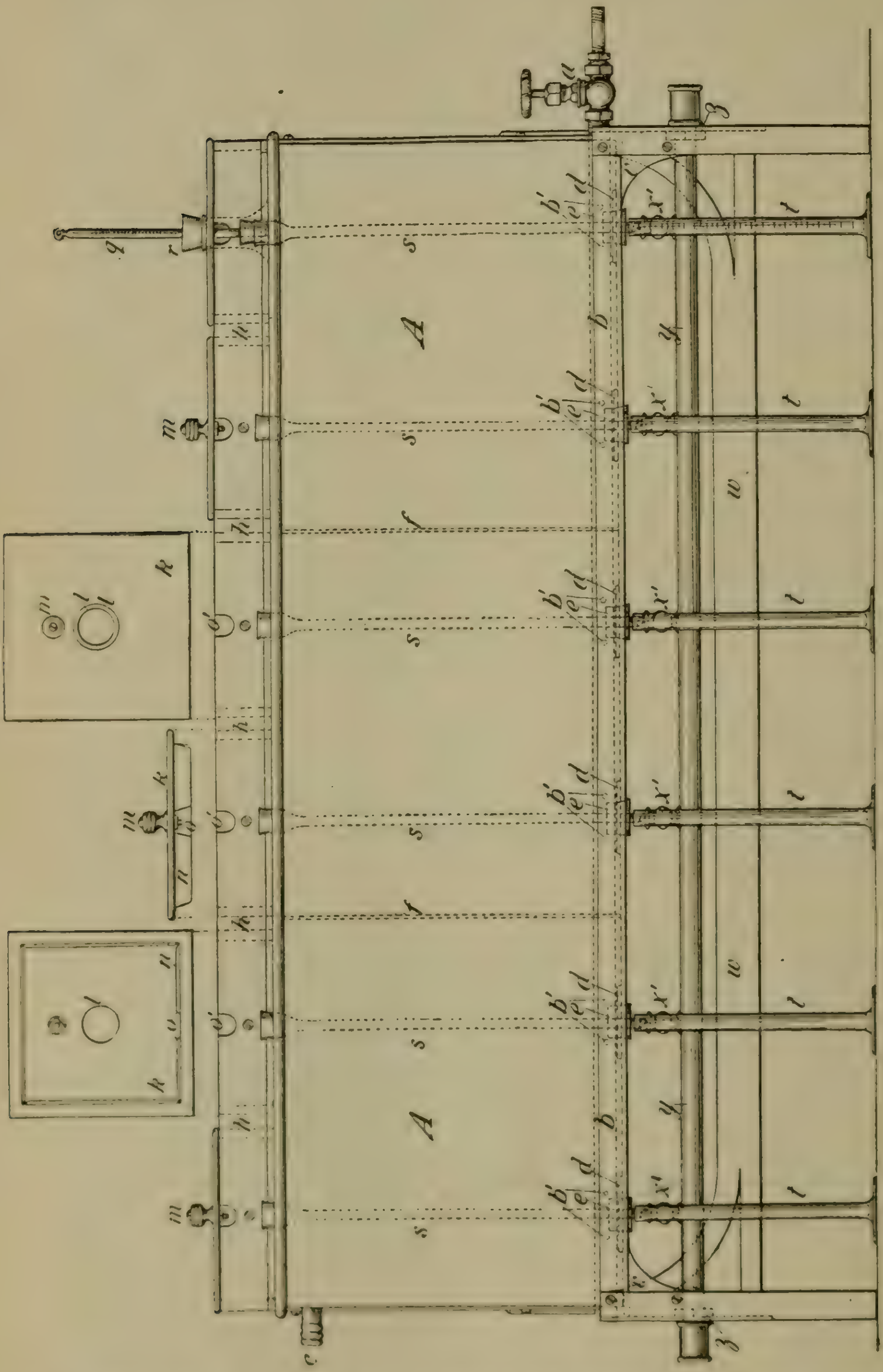


FIG. 3.—Plan of front of apparatus for moisture determination.

A, condenser; *a*, valve on cold-water pipe; *b*, water pipe along bottom of tank; *b'*, diagonal holes in pipe opening into tank; *c*, overflow pipe; *d*, heavy washers; *e*, rubber stoppers supporting condenser tubes; *f*, braces on sides of tank; *h*, air space between compartment partitions in evaporating chamber; *k*, covers; *l*, hole in cover for neck of flask; *m*, wooden handle on cover; *n*, flange on cover; *o*, notch in flange; *o'*, notch in front of evaporating chamber; *q*, thermometer in flask; *r*, rubber stopper supporting thermometer; *s*, glass condenser tubes; *t*, graduated measuring cylinders; *v*, braces on stand; *w*, cross piece on back of stand; *x'*, extra stopcock at base of burner; *y*, gas pipe; *z*, nuts for adjusting height of gas pipe.

The front of the evaporating chamber and the two ends (figs. 4 and 5) rest on an iron stand (*C*), while the wall at the back of the chamber extends only to the line *u u'*, which is 5 inches above the base. (See fig. 4.) This side is left partially open to facilitate the lighting of the burners and to give a better supply of air. A 2-inch hole should likewise be cut in each end of the apparatus about 4½ inches from the base, in order to give a greater supply of air to the two end burners; this, however, is not shown in the illustrations.

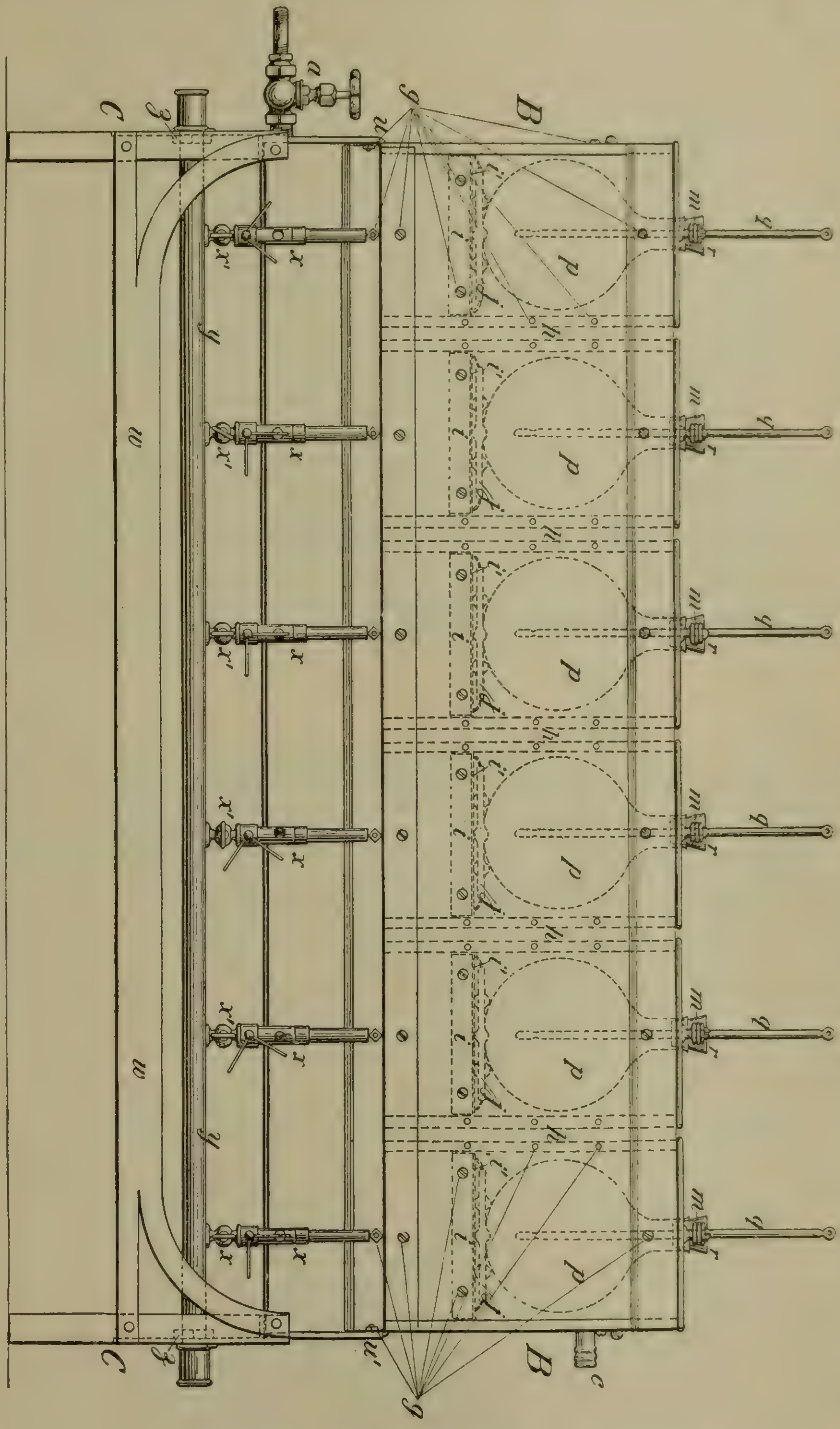


FIG. 4.—Plan of back of apparatus for moisture determination.

B, evaporating chamber; *C*, stand supporting evaporating chamber and condenser; *a*, valve on water pipe; *c*, overflow pipe; *g*, screw bolts; *h*, air space between partitions; *i*, ledge supporting gauze, triangle, and flasks; *i'*, galvanized iron ring above wire gauze; *j*, flanged pipestem triangle; *m*, wooden handle on covers; *p*, distillation flasks; *q*, thermometers in flasks; *r*, rubber stopper carrying thermometers; *u u'*, lower line of outside wall of evaporating chamber; *w*, cross-piece on back of stand; *x*, burners; *x'*, extra stopcock beneath burners; *y*, gas pipe; *z*, nuts for adjusting gas pipe.

The different parts of the evaporating chamber, including the asbestos lining and covering, are fastened together with the screw bolts (figs. 4 and 5, *g*). The different compartments are each made $5\frac{3}{8}$ inches square inside, and are separated from each other by two partitions, each with a double thickness of asbestos, and a quarter-inch air space (*h*), so that when the heat is turned off from one compartment the sample of corn in the flask within will in no way be affected by the heat from an adjoining compartment should it still be in operation. These partitions extend $2\frac{1}{2}$ inches below the ledges (*i*) which support the flasks (*p*), in order to prevent the flame of any one burner from spreading into an adjoining compartment. Within each compartment, $6\frac{1}{2}$ inches from the top of the chamber, is a galvanized-iron ledge (*i*) for supporting the wire gauze, flask, etc., the ledge being cut in such a way as to form a hole $4\frac{1}{2}$ inches in diameter. In order to prevent the brass-wire gauze from becoming badly distorted by the action of the heat, it should be held in place by means of a second piece of galvanized iron (*i'*), which fits into the compartment and has a hole of the same diameter as the support (*i*).

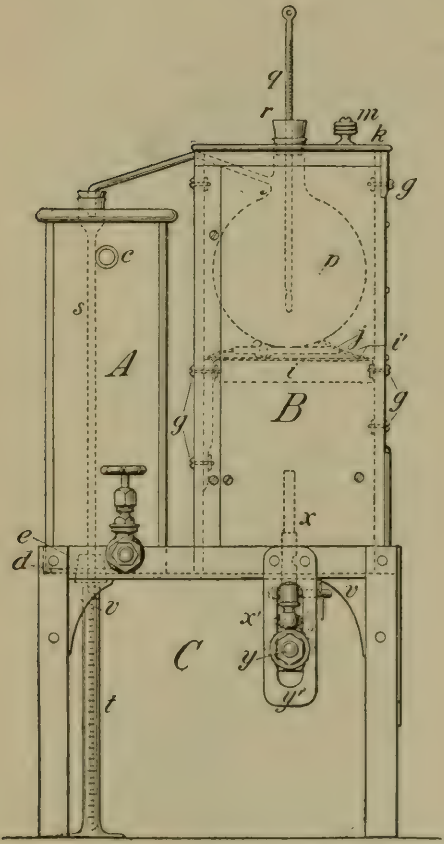


FIG. 5.—Plan of end of apparatus for moisture determination.

A, condenser; *B*, evaporating chamber; *C*, stand-supporting condenser and evaporating chamber; *c*, overflow pipe; *d*, washer soldered to bottom of condenser tank; *e*, rubber stopper supporting condenser tube; *g*, screw bolts; *i*, ledge for supporting gauze, triangle, and flask; *i'*, galvanized iron ring above gauze; *j*, flanged pipestem triangle; *k*, covers; *m*, handle on cover; *p*, distillation flask; *q*, thermometer; *r*, rubber stopper; *s*, condenser tube; *t*, graduated measuring cylinder; *v*, braces; *x*, burner; *x'*, extra stopcock beneath burner; *y*, gas pipe; *y'* support for gas pipe.

On the plate holding the gauze firmly in place (see fig. 4) rests a flanged pipestem triangle (*j*), which serves to raise the flask (*p*) about one-half inch above the brass-wire gauze, this being essential in order to prevent the corn which lies directly on the bottom of the flask from becoming too highly heated. If the flask rests on the gauze, the kernels in contact with the bottom of the flask directly over the flame will become carbonized and the percentage of water expelled will be too large. The interior arrangement of each compartment is more clearly shown in figure 9. The length of the flanged pipestem forming the sides of the triangle is 4 inches. The gauze is 30-mesh, made of No. 31 brass wire.

Each compartment is provided (see fig. 3) with an asbestos-lined cover (*k*) having a hole (*l*) in the center, thru which the neck of the flask (*p*) projects. The hole in the galvanized iron is made about one-fourth inch larger than the hole in the asbestos lining, the latter having

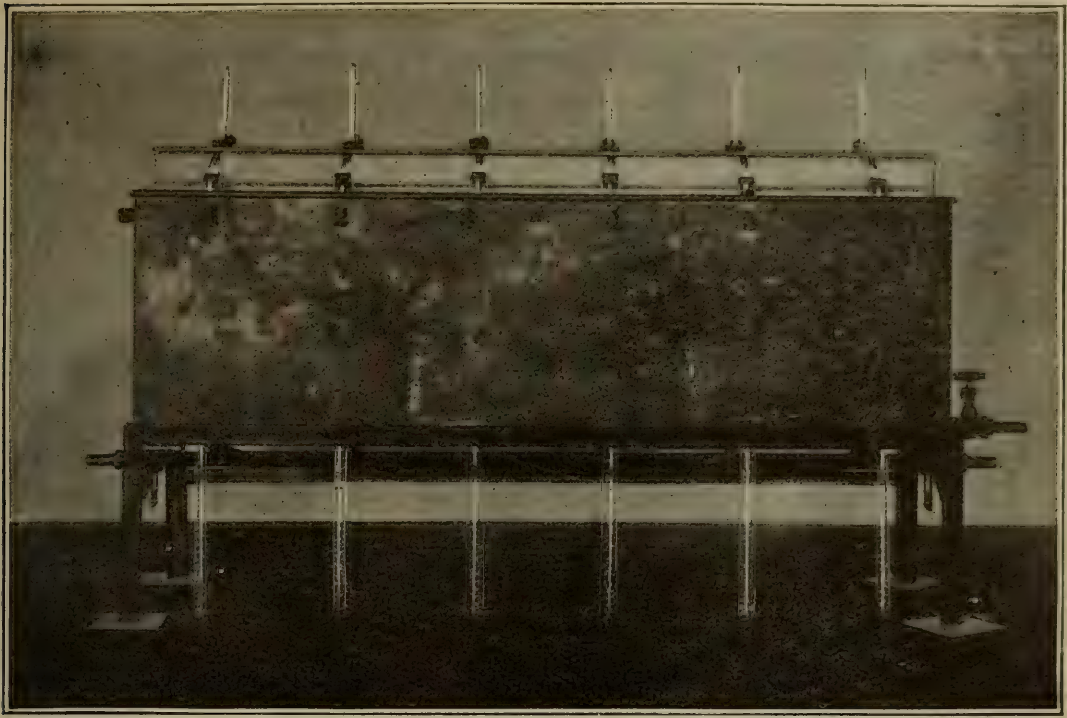


FIG. 6.—Front view of apparatus for moisture determination.

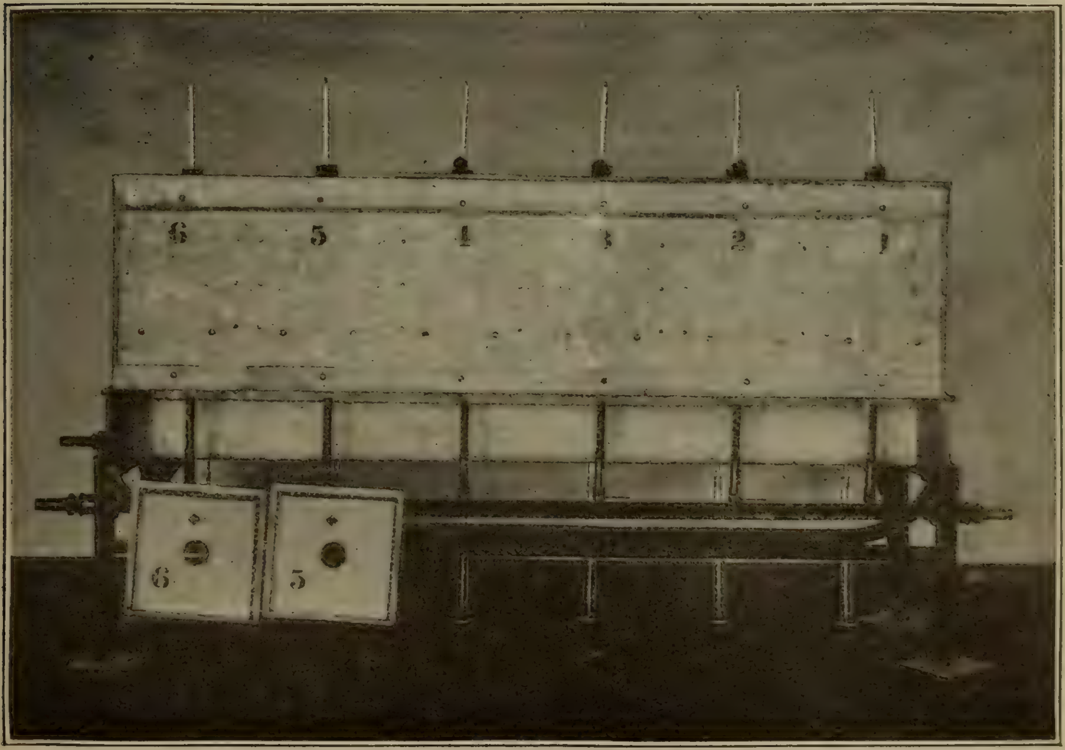


FIG. 7.—Back view of apparatus for moisture determination.

a diameter of 1¼ inches, thus forming a one-eighth inch asbestos projection (*l′*) to lessen the danger of breaking the necks of the flasks in placing or removing the covers. Each cover is provided with a wooden handle (*m*) and a five-eighths inch flange (*n*), the latter having a small notch at *o*, directly opposite the notch (*o′*) in the side of the chamber. The asbestos in the notch (*o′*) in the wall of the chamber should project sufficiently to form a cushion to protect the glass tube leading thru the notches *o*, *o′* to the condenser.

THE CONDENSER.

The condenser (figs. 3 and 5, *A*) consists of a plain copper tank 4 inches wide, 12 inches high, and of the same length as the evaporating chamber (*B*). In the bottom of the tank at points directly opposite the center of each of the compartments of the evaporating chamber are cut 1-inch holes for receiving the perforated rubber stoppers (*e*) thru which the ends of the glass condenser tubes (*s*) project into the measuring cylinders (*t*). Heavy one-eighth inch washers (*d*) are soldered around the holes in the bottom of the tank, so that the rubber stoppers (*e*) bearing the condenser tubes (*s*) can be prest in firmly, thereby avoiding the possible danger of any water leaking from the tank into the measuring cylinders. Thru the condenser tank passes a stream of cold water, entering thru the valve (*a*) and passing out at the overflow pipe (*c*). Connected with the valve (*a*) is a three-eighths inch pipe (*b*), which extends the full length of the tank. In this pipe, near each condenser tube, are two small holes (*b′*), drilled at such an angle that the cold water entering the tank will fall directly on the glass condenser tubes. In order to prevent the sides of the tank from bulging, extra braces (*f*) should be put in every 16 or 18 inches.

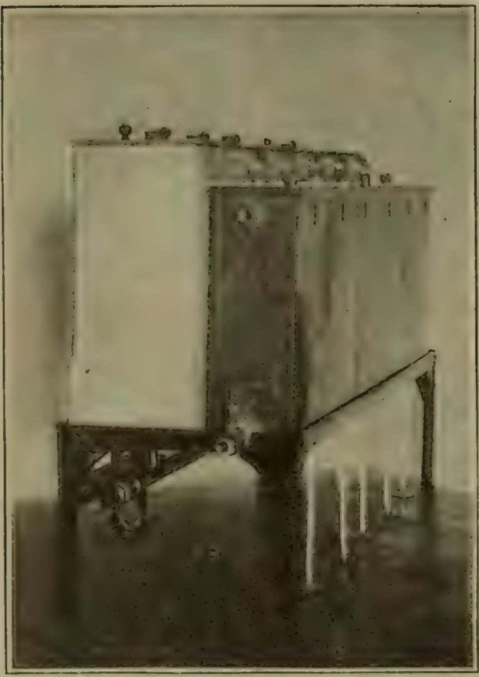


FIG. 8.—End view of apparatus for moisture determination.

THE STAND SUPPORTING THE EVAPORATING CHAMBER AND CONDENSER.

The stand (see figs. 3 and 5) supporting the condenser (*A*) and the evaporating chamber (*B*) is made of angle iron, with 1-inch sides and three thirty-seconds inch thick. The total height of the stand is 9¼ inches, which raises the bottom of the condenser tank 8¾ inches above the work table, leaving ample room for the 8-inch measuring flasks (*t*) to be placed under the condenser tubes. The corners of the stand are strengthened by the braces (*v*). The cross piece (*w*) at the back of the stand is dropt 4 or 5 inches in order to facilitate the manipulation of the burners.

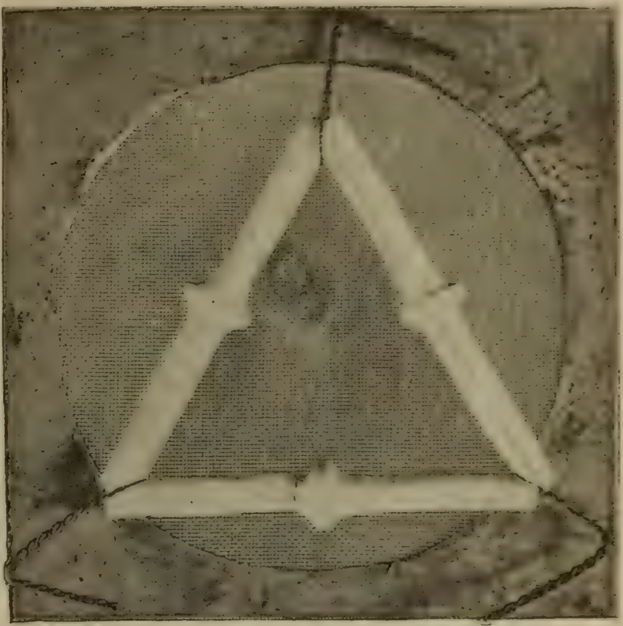


FIG. 9.—Interior arrangement of the compartments of the evaporating chamber, showing the position of the triangle over the gauze.

Between the burners (*x*) and the gas pipe (*y*) is inserted an extra stopcock (*x′*). With the extra stopcock directly beneath the burners the flow of gas can be regulated by setting either the valve in the burner (*x*) or the stopcock (*x′*), using the remaining one for turning on and off the gas. (Figs. 3 and 5.) The gas pipe (*y*) with the attached burners can be raised or lowered by loosening the nuts (*z*) at the slotted supports (*y′*) at either end of the stand.

THE DISTILLATION FLASKS.

The flasks (figs. 4 and 5, *p*) in which the mixture of corn and oil is heated are primarily distillation flasks having short necks and specially constructed side tubes. (Fig. 10.)

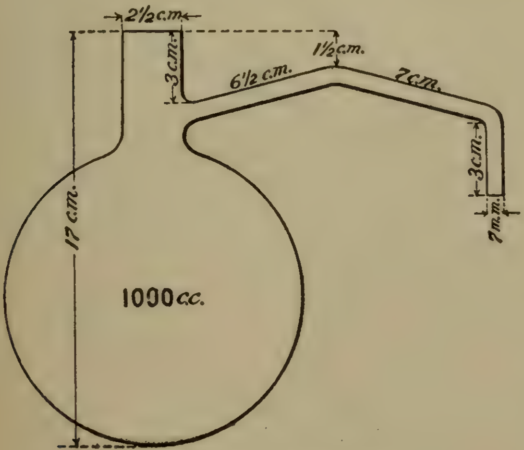


FIG. 10.—Distillation flask.

The flasks have a capacity of approximately 1,000 cubic centimeters. The necks of the flasks have a diameter of 2½ centimeters and are made without a flange and sufficiently heavy to stand tight corking. The side tube, which is 7 or 8 millimeters in internal diameter, is inserted approximately 3 centimeters from the top of the neck. The respective lengths of the three arms of the side tube are 6½, 7, and 3 centimeters. The bend between the two long arms is 1½ centimeters below a horizontal line drawn from the top of the neck of the flask. The total height of the flasks should be 17 or 17½ centimeters, or such that one-half centimeter or more of the neck will protrude thru the covers (*k*) of the evaporating chamber in order to protect the rubber stoppers (*r*) as much as possible from the action of the high temperatures.

THE THERMOMETERS.

While any standard chemical thermometer may be utilized, a thermometer graduated in degrees from 100° C. to 210° C. has been found most convenient. The 100-degree mark should come just at the top of the rubber stopper in the flask (17 centimeters from the bulb end of the thermometer), so that the rapidity of the rise in temperature can be watched if desirable after the water begins to pass over. The total length of such a thermometer need not be more than 27 or 28 centimeters. The bulb end of the thermometer should extend well into the mixture of corn and oil, approximately 1 centimeter from the bottom of the flask.

THE CONDENSER TUBES.

The construction of the condenser tubes (figs. 3 and 5), as represented at *s* in the detailed drawings, is shown in figure 11. The thimble at the top is 22 millimeters in diameter inside and 3 centimeters deep, giving ample space to make good connection with the distillation flasks by means of a rubber stopper on the end of the side tubes. The diameter of the remaining part of the tube is approximately 7 millimeters, the tube having a total length of 33 centimeters, so that the top of the tube will stand about one-half centimeter above the top of the water tank and the bottom of the tube project about 2 centimeters below the rubber stopper *e* at the bottom of the tank. The lower end of the tube should be cut at an angle, as shown in the illustration.

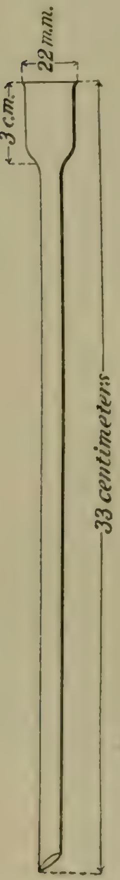


FIG. 11.—Condenser tube.

THE GRADUATED CYLINDERS FOR COLLECTING AND MEASURING THE WATER.

A convenient form of container for collecting and measuring the amount of water expelled from the grain is shown in figure 12. Each of the two cylinders here shown is 20 centimeters (approximately 8 inches) high and is graduated in fifths, the one with a reading capacity of 20 cubic centimeters and the other with a reading capacity of 25 cubic centimeters. For samples of very wet grain larger measuring cylinders will be necessary. With the graduations in fifths it is very easy to make the reading in tenths of a per cent. which is a sufficiently close percentage for all commercial grading of grain, as samples taken on different days will show a much wider variation. The graduations are in cubic centimeters, so that when 100 grams of grain are used for the test the percentage of water can be seen at once, 1 cubic centimeter of water representing 1 per cent. The cylinders should be of a uniform height, so that they can be used indiscriminately beneath any of the condenser tubes.

In expelling the water from the corn a small quantity of oil (less than one-half a cubic centimeter) is carried over into the graduated cylinders, which prevents them from drying rapidly after the readings have been made and the contents emptied at the close of the test. However, preparatory to their being used again the cylinders must be cleaned and dried, which can best be done with a test-tube cleaner having a small piece of sponge attached to the end.

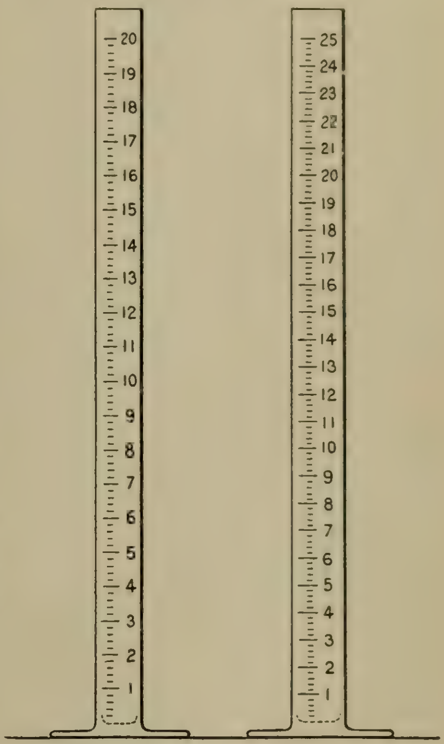


FIG. 12.—Graduated cylinders for measuring the water expelled from the grain.

COMPARISON OF RESULTS WITH DETERMINATIONS MADE IN A WATER OVEN.

The method and the apparatus for making moisture determinations of corn as described in the foregoing pages is so radically different from that commonly used in chemical laboratories that a comparison of results seems advisable.

Duplicate tests were made according to the rapid method and likewise in a water oven, the average percentage of moisture obtained in each case being shown in Table I.

TABLE I.—*Moisture in corn samples as determined by quick method and in water oven.*

Sample No.—	Moisture determined by quick method.	Moisture determined in water oven.	Sample No.—	Moisture determined by quick method.	Moisture determined in water oven.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
1	13.10	12.93	15	13.30	12.93
2	13.20	12.88	16	12.80	12.84
3	26.15	26.01	17	20.40	20.24
4	14.05	13.75	18	24.85	24.58
5	13.43	13.44	19	26.90	26.90
6	27.05	26.73	20	21.55	20.98
7	22.25	22.00	21	20.44	20.32
8	20.40	20.57	22	19.00	19.08
9	13.45	13.42	23	17.76	17.74
10	18.15	17.94	24	12.05	12.10
11	12.43	12.39	25	20.35	20.31
12	20.44	20.21	26	13.48	13.23
13	13.55	13.42	27	11.60	11.54
14	11.90	11.86	28	13.14	13.01

From the 28 samples represented in the foregoing table the average moisture obtained, according to the quick method, was 17.40 per cent and the average of the determinations made in a water oven was 17.26 per cent, a difference of 0.14 per cent. This difference is favorable to the quick method, for the percentage of moisture obtained by drying starchy grains in a water oven is slightly below the actual amount of free water in the grain.

In the majority of cases the whole kernels were likewise used for making the moisture tests in the water oven, the drying being continued from ninety-six to one hundred and twenty hours, and in the case of exceptionally hard kernels the drying was prolonged to one hundred and thirty-six hours or more.

The whole kernels were used in order to obviate the loss of water due to grinding, which in case of samples having a high percentage of moisture is considerable. One sample gave 26.01 per cent from the whole kernels and 24.36 per cent from the ground sample; another, 35.68 per cent from the whole kernels and 34.75 from the ground sample. The average of 16 samples gave 20.13 per cent for the whole kernels and 20.05 per cent for the ground sample, the moisture content of the different samples varying from 12.71 per cent to 35.68 per cent.

VARIATIONS IN DUPLICATE TESTS.

The amount of variation in different tests made at the same time from the same lot of corn will depend largely on the uniformity of the samples and on the care of the operator.

If the corn being analyzed is of inferior quality, containing a number of rotten kernels, or is a mixture of wet and dry corn, it is almost impossible to get samples of 100 grams each which will give the same results, and in such cases a variation of one-half of 1 per cent or more is to be expected, whatever method is used for determining the percentage of moisture. But if the corn being examined is of uniform quality and the moisture determinations are carefully made, the variation in the results of duplicate tests will usually not exceed one-fifth of 1 per cent, while many samples will give a much smaller variation. However, a variation of even one-half of 1 per cent is sufficiently close for all commercial work, inasmuch as two samples taken on different days or from different parts of the same car or cargo will generally show a much greater variation than this.

Table II shows the results of the determinations of 15 samples of corn, representing almost all grades from new corn to wet and larvæ-eaten samples, in which the average variation is 0.22 per cent.

TABLE II.—*Variations in the percentage of moisture obtained from different tests made from the same lot of corn.*

Sample No.—	Moisture.						Average.	Variation.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	11.95	11.8	12.1	11.8	11.8	11.95	11.9	0.3
2	13.15	13.1	13.2	13.1	13	13.3	13.14	.3
3	11.4	11.75	11.7	11.4	11.75	11.7	11.6	.35
4	13.2	13.1	13	13.1	13	13.4	13.16	.4
5	17.7	17.6	17.7	17.5	17.9		17.68	.3
6	13.8	13.4	13.9	13.7			13.7	.5
7	20.4	20.3	20.7	20.3			20.4	.4
8	11.3	11.3	11.3				11.3	.0
9	20.7	20.9					20.8	.1
10	26.2	26.1					26.15	.1
11	13.2	13.2					13.2	.0
12	27	27.1					27.05	.1
13	24.8	24.9					24.85	.1
14	34.8	35					34.9	.2
15	35.9	36.05					35.98	.15

SUMMARY.

(1) The principal cause of the deterioration of corn in storage or during transit is an excessive amount of moisture.

(2) With the method and apparatus herein described for making moisture determinations, a percentage system of grading corn is well within the possibilities of the trade.

(3) The method described consists primarily in heating a definite quantity of corn in an oil bath to drive off the water, which is condensed and measured in a graduated cylinder.

(4) The time required for making the moisture determination will be from twenty to twenty-five minutes.

(5) With the proposed quick method for making moisture determinations one man familiar with laboratory work, with an assistant, should be able to test 200 samples in a day of eight hours.

(6) The apparatus consists primarily of (*a*) an evaporating chamber divided into two or more compartments, (*b*) a copper tank forming the condenser, and (*c*) a stand to support the evaporating chamber, the condenser, and the burners.

(7) The apparatus described shows six compartments, but it can be made in any size desired.

(8) The whole kernels are used for the test, no time being consumed by grinding; moreover, damp or wet grain can not be ground without a considerable loss of moisture.

(9) Only one weighing is required, for which an ordinary torsion balance is used, a delicate analytical balance being entirely unnecescessary.

(10) One hundred grams of corn are used for the test; consequently, each cubic centimeter of water in the graduated cylinder represents 1 per cent of moisture.

(11) When the thermometer in the distillation flask registers 190° C. (374° F.) the gas should be turned off, after which eight or ten minutes must elapse before the reading of the amount of water expelled is made.

(12) The distillation flask is closed and connected with the condenser tube by means of rubber stoppers of a grade that will not be readily affected by high temperatures.

(13) The oil used is a good grade of pure hydrocarbon oil having a flash point (in open cup) of from 200° C. to 205° C. Such oils are sold in the market as "engine oils" and can be purchased in barrel lots for 12½ or 15 cents a gallon.

(14) The oil should be poured into the flask first to lessen the danger of its being broken by the kernels of corn dropping on the bottom.

(15) The bulk samples from which the 100-gram samples are taken for the moisture test must be kept in air-tight containers if accurate results are expected.

(16) The bulk samples should be taken in such a was as to represent the quality of the entire lot of grain under consideration.

O

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART I.
B. T. GALLOWAY, *Chief of Bureau.*

CRANBERRY SPRAYING EXPERIMENTS IN 1905.

BY

C. L. SHEAR, PATHOLOGIST.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

ISSUED FEBRUARY 7, 1906.

239431
13 1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

Page.
Introduction 3
Spraying and its results 4
Importance of early applications 5
Effects of spraying plants when in full bloom 6
Keeping qualities of sprayed and unsprayed fruit 6
Cost and recommendations 7

ILLUSTRATION.

TEXT FIGURE.

Page.
FIG. 1. The apparatus used in the spraying experiments 4

B. P. I.—200. V. P. P. I.—150.

CRANBERRY SPRAYING EXPERIMENTS IN 1905.

INTRODUCTION.

In Farmers' Bulletin No. 221[1] a brief account was given of cranberry diseases and also the results of spraying experiments with Bordeaux mixture. The results in 1904 were not entirely satisfactory. This was not due, however, to the inefficiency of Bordeaux mixture, but to circumstances which prevented the applications being made at proper intervals. The results obtained in 1904 showed an average of 21.7 per cent of rotten berries on the sprayed plats, as compared with an average of 76.8 per cent rotten on the unsprayed check plats. Considering the unsatisfactory manner in which the Bordeaux mixture was applied, the prediction was ventured that it would be possible with more thorough treatment to reduce the loss from rot to 10 or 15 per cent. The results obtained in 1905 have more than justified this prediction.

The experiments were conducted on what is known as the Bunker Hill bog at Whitesville, N. J., which is in charge of Mr. James D. Holman, the same plats being used as in 1904, with the addition of a small area not heretofore sprayed. This bog was selected because the fruit has in former years been almost entirely destroyed by disease. The water was drained from the bog May 10–12. It is the usual practice of cranberry growers to flood bogs for twenty-four hours during the first week in June, in order to destroy insects. In these experiments it was planned to spray part of the experimental plats before this second flooding and part immediately afterwards, in order to determine the necessity or desirability of spraying before this flooding. The water supply of the bog was, however, insufficient to flood it at the usual time, and it was not done.

The spraying apparatus used was a barrel and force pump fitted with two lengths of half-inch hose, each length provided with an extension rod and two Vermorel nozzles. The apparatus was driven about the bog in a low-bodied spring wagon, as shown in figure 1.

The Bordeaux mixture used consisted of 6 pounds of copper sulphate (bluestone) and 6 pounds of fresh stone lime to 50 gallons of water, to which was also added 4½ pounds of commercial resin-fishoil soap. The addition of this soap has been found to be indispensable, as Bordeaux mixture will not spread over and adhere satisfactorily to the glossy surface of the cranberry leaves and fruit without it. Heretofore this soap has been made as it was needed for use. Its manufacture was not an altogether pleasant operation. Now that the soap is being manufactured and placed on the market at about 3 cents per pound, it is cheaper and much more convenient to purchase it than to make it.

---

[1] Farmers' Bulletin No. 221, U. S. Dept. of Agriculture, "Fungous Diseases of the Cranberry."

SPRAYING AND ITS RESULTS.

The sprayed plats were numbered 3, 5, 6, 7, and 9, the plats between being left as checks. Plats 3 and 7 were sprayed five times, as follows: May 19, June 22–23, July 14–17, July 31–August 1, and August 15–17. On September 8 accurate counts were made of all the diseased and sound berries on small areas, showing the average condition of the berries on the sprayed plats; also of equal areas, showing the average condition of the berries on the check plats. Plat 3 gave 3.23 per cent of rotten berries, plat 7 gave 8.8 per cent of rotten fruit, check plat 2 showed 91 per cent of rotten fruit, check plat 8 gave 91.53 per cent of rotten berries, giving an average of a fraction over 6 per cent of rotten fruit for the sprayed plats and a little more than 91 per cent for the unsprayed plats. On these two plats it will be noted that the first application was made on May 19, when the vines had but just commenced to put out new growth. This application was the one mentioned as being made before the usual flooding for insects.

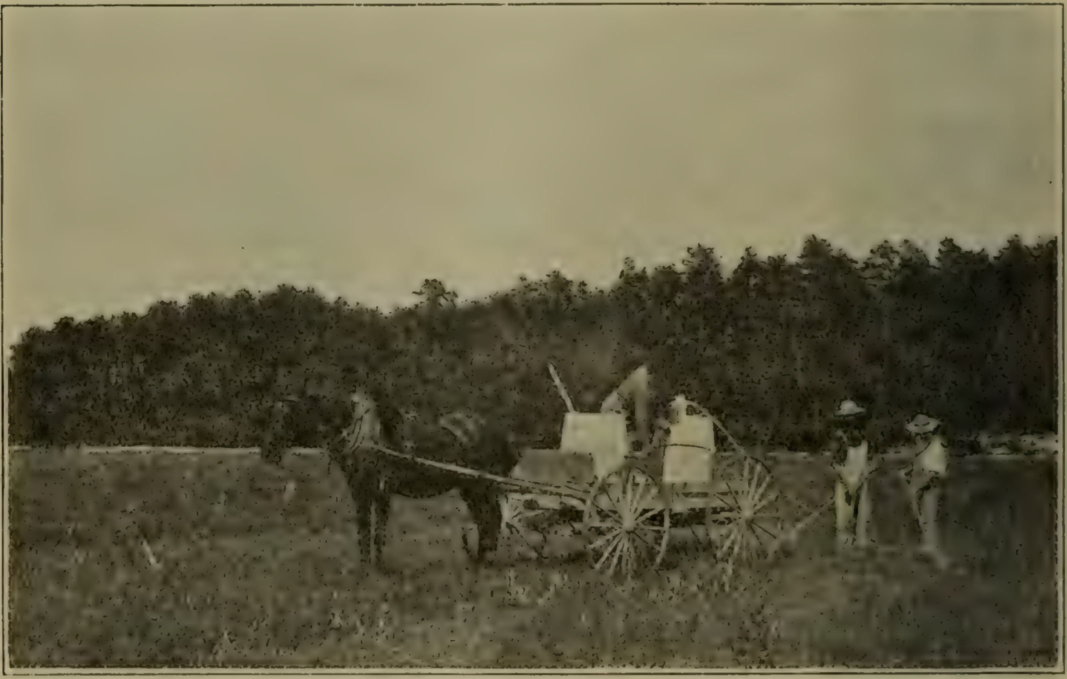


FIG. 1.—The apparatus used in the spraying experiments.

Plats 5 and 9 were sprayed five times, as follows: June 2, June 22–23, July 14–17, July 31–August 1, and August 15–17. On June 2, when the first application was made to these plats, there was a good growth of young shoots and leaves. Counts of fruit on small areas, as in the preceding case, gave the following results: Sprayed plat 5, 2.62 per cent of rotten berries; sprayed plat 9, 2.1 per cent of rotten fruit; check plat 4, 91.8 per cent rotten; check plat 10, 93.5 per cent rotten, giving an average of 2.36 per cent of rotten berries on the sprayed plats and 92.6 per cent of rotten fruit on the unsprayed plats. There was very little difference in the amount of rot on this series of plats and that on the series mentioned in the preceding paragraph.

Plat 6 was sprayed but three times, as follows: July 14–17, July 31–August 1, and August 15–17. Counts made, as in the previous cases, on September 8, gave the following results: Sprayed plat, 18.3 per cent of rotten berries; check plat, 91.53 per cent of rotten fruit. It may also be added that a greater number of the berries from this sprayed plat decayed before they were ready for shipment than was the case with the fruit from the plats which received five applications.

The fruit from an area of 1,048 square feet, showing average condition of fruit on sprayed plat 7, was carefully hand picked and produced 3 bushels of sound fruit, which is at the rate of about 125 bushels per acre. The same area from check plat 8, showing the average condition of fruit, gave a scanty peck, or at the rate of about $10\frac{5}{12}$ bushels per acre. In other words, there was twelve times as much sound fruit on the sprayed as on the unsprayed plat, or a saving of over 100 bushels per acre.

Besides our purely experimental plats, several acres upon another cranberry bog known as "Long Swamp" were sprayed by Mr. Holman. One portion was sprayed five times on the following dates: June 6–10, June 26–28, July 18–21, August 2–4, and August 18–19. One part was sprayed only four times. The first plat, which was also sprayed in 1904, was estimated to have from 80 to 100 per cent of the fruit sound on September 15. On the area sprayed only in 1905 it was estimated that from 70 to 90 per cent of the fruit was sound. On the plat which only received the first four applications the fruit showed somewhat more rot than on the other plats at picking time. The fruit on these plats has in former years been almost entirely destroyed by rot.

IMPORTANCE OF EARLY APPLICATIONS.

The difference in the appearance of the fruit on the sprayed and unsprayed plats was very marked by the middle of July. On the unsprayed plats a large proportion of the fruit was blasted, owing to the early attack of the scald fungus (Guignardia), while on the sprayed plats but little blasted fruit was to be seen. In many cases at least one-half of the fruit is destroyed by blasting, the young fruits being attacked by the fungus at about the time the blossoms begin to fall. In order to prevent this, one of the applications of Bordeaux mixture should be made immediately after the vines have reached their maximum flowering stage, as a delay of a week at this time may make a difference of from 25 to 50 per cent in the amount of fruit destroyed by blasting.

A very striking illustration of this fact was observed upon another bog where one plat had been sprayed on July 1 and another adjoining was not sprayed until July 8. On the plat sprayed on July 1, when the vines had just reached their maximum flowering condition, but very little blasted fruit could be found, whereas on the plat which had been sprayed on July 8 about one-half of the fruit had been blasted. This and other observations indicate the exceedingly great importance of prompt and thorough early applications of the fungicide. In case the bog to be sprayed is flooded for insects early in June, the first application of Bordeaux mixture should be made within a day or two after the water is removed, the second application just as the plants begin flowering, and the third just after the majority of the blossoms have appeared, which in ordinary seasons will be about the first of July.

EFFECT OF SPRAYING PLANTS WHEN IN FULL BLOOM.

In order to determine whether any injury would result from spraying the plants while in bloom, part of one plat was sprayed when in full bloom, and the amount of fruit which set upon this plat was carefully compared with that on adjoining plats which had not been sprayed. No difference could be noted in the amount of fruit on the sprayed and on the unsprayed plats. In addition, certain bunches of vines were dipped in Bordeaux mixture when in full bloom, but without any apparent injury to the fruit. From our observations and experiments it does not appear that there is much danger of loss from spraying vines while in bloom. What little loss might possibly arise from this cause would be very slight compared with the amount of loss from blasted fruit in case the spraying was delayed too long.

KEEPING QUALITIES OF SPRAYED AND UNSPRAYED FRUIT.

A comparison of the sprayed and unsprayed fruit at the time of picking does not give an exact idea of the amount of profit derived from the treatment, as there was a much greater loss of unsprayed than of sprayed fruit between the time of picking and the time the berries were marketed.

In order to compare the keeping qualities of the sprayed and unsprayed fruit, as well as unsprayed fruit which had been treated with a solution of copper sulphate (1 part to 1,000 of water), 3,600 berries, perfectly sound so far as could be seen from external appearance, were selected from fruit picked on September 18, 1905. Of these, 1,200 were from the sprayed plats and the remainder from the unsprayed check plats. These berries were kept in glass dishes in the laboratory and counted each week, in order to determine the amount of disease which developed. On October 18, about the time the fruit from the bog was marketed, 9.8 per cent of the sprayed fruit showed diseased berries, while 38.1 per cent of the unsprayed fruit and 37.4 per cent of the unsprayed fruit which had been treated with the copper-sulphate solution were diseased. In other words, four times as much of the unsprayed fruit decayed between the time of picking and marketing as of the sprayed fruit.

Parts of the check plats which were worth picking were picked by hand and the fruit kept separate. This fruit was sorted for shipment on October 15, 1905, when from 85 to 90 per cent of it was rotten. Mr. Holman states that 40 per cent of all the unsprayed berries from Bunker Hill bog decayed between the time of picking and marketing. No treatment of the berries with fungicides after picking is likely to give satisfactory results. as we have found that the decay which occurs in storage does not arise from germs which are on the surface of the fruit at the time it is picked, but apparently from a dormant form of the fungus already within the berries, where it is awaiting favorable conditions for development.

As the time for picking approached, so much of the Bordeaux mixture adhered to the sprayed fruit that it was feared enough might be present when the berries were marketed to interfere with their sale. This, however, did not prove to be the case, as the greater portion of the mixture was removed from the fruit during the process of picking, sorting, and preparing the fruit for market.

As the result of three years' spraying experiments, it is safe to say that by the proper use of Bordeaux mixture the loss from fungous diseases can be reduced to 10 per cent or less. The loss may be slightly more the first year a badly diseased bog is treated, as the benefit, as shown in these experiments, is greater the second year than the first, and is evident not only in the prevention of scald and rot of the fruit, but in the general improvement, thriftiness, and productiveness of the vines. Bordeaux mixture has also been applied with very beneficial results to young vines not yet in bearing, the leaves of which were badly affected by the scald fungus.

COST AND RECOMMENDATIONS.

The cost of the spraying as it was done in these experiments averaged from $15 to $20 an acre, the mixture being applied at the rate of four barrels, or 200 gallons, an acre at each application, making for the five applications a total of 1,000 gallons to the acre.

In undertaking the application of Bordeaux mixture it is necessary that all material and apparatus be in perfect readiness before the time to begin the work, and nothing should be allowed to interfere with the application of the fungicide at proper intervals; otherwise, the results will be unsatisfactory, and the remedy is likely to be unjustly condemned.

The necessity for care and thoroughness in the preparation and application of the mixture must also be strongly emphasized. The mixture should be made as described in Farmers' Bulletin No. 221, using only good, fresh stone lime and adding resin-fishoil soap. A good nozzle (the Vermorel type is best) should be used and the vines very thoroughly covered at each spraying. Four barrels of the mixture to the acre are ordinarily sufficient, but where the vines are very dense and heavy five barrels may be necessary. Where there is an excessive growth of vines, it will be found advantageous to rake them with a knife rake and thin them out, as is frequently done in order to prepare a bog for picking with scoops.

○

Gov. Doc.
U.S.
Ap

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART II.
B. T. GALLOWAY, *Chief of Bureau.*

THE WRAPPING OF APPLE GRAFTS AND ITS RELATION TO THE CROWN-GALL DISEASE.

BY

HERMANN VON SCHRENK,
SPECIAL AGENT IN CHARGE OF THE MISSISSIPPI VALLEY LABORATORY,

AND

GEORGE G. HEDGCOCK, ASSISTANT IN PATHOLOGY.

ISSUED FEBRUARY 28, 1906.

239414a
3.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

	Page.
Introduction	5
Account of experiments	6
Manner of wrapping	7
Cloth	7
Rubber	7
Waxed paper	7
Plain thread	7
Waxed thread	7
Plain thread with union waxed	7
Grafts left unwrapped	7
Results of wrapping	7
Effect upon the union	8
Effect on crown-gall formation	9
Recommendations	10
Suggestion to nurserymen	10
Summary	11

THE WRAPPING OF APPLE GRAFTS AND ITS RELATION TO THE CROWN-GALL DISEASE.

INTRODUCTION.

The crown-gall disease of apple trees, as indicated in a recent publication of the Bureau of Plant Industry,[1] appears in three distinct types—the hard crown-gall, the soft crown-gall, and the hairy-root forms. While the hairy-root disease of apples has usually been considered as a type of the crown-gall disease, it in reality is an entirely different trouble, with manifestations which are not in the least like those met with in the true crown-gall disease. The soft type of crown-gall on the apple has not yet been clearly differentiated from the hard type, and in the following discussion the two are considered as one.

The knots which characterize the crown-gall disease of the apple usually appear at some point, either on the root piece or on the scion, where the two are united; that is, the gall may form at the end of the tongue of either the scion or root piece, or at any point where either piece has been wounded. This fact is one commonly recognized by all nurserymen and scientific workers who have studied this disease. About 90 per cent of these knots will appear on the end of the scion piece. The exact cause of the formation of the gall is as yet somewhat uncertain. It would seem, however, that, whatever the cause, the point most exposed to the disturbing factor, whether it be due to a fungus, to bacteria, or to soil or atmospheric conditions, is the junction of the scion and root piece.

When the newly made grafts are laid away in the grafting cellar either in sawdust, excelsior, moss, or other bedding material, callous tissue begins to form on the cut surfaces of both scion and root piece. This callous tissue from the two pieces will in time fill the intervening spaces between the surfaces of the scion and the root piece, and ultimately the root callus and the scion callus will join. Where the root piece and the scion are of exactly the same size and where they are united so as to fit exactly, a very perfect union will take place. Where there is a difference in size between the root piece and the scion, or where they are more or less imperfectly fitted, as is almost always the case in commercial grafts, the callus formed by the scion and the root piece will not always meet along equal planes. In these cases there will be a tendency for the callus forming on any surface of either piece which is not in direct contact with an opposite surface (no matter how small this surface may be) to grow out from this surface, either laterally or down or up out into the air, with nothing to prevent its growing into small lumps, which may reach considerable size. Very frequently the pressure exerted by the growing callus will push the tongue of the graft outward. A thick cushion of callus will then form between the scion and root piece.

---

[1] Bulletin No. 90, Part II, Bureau of Plant Industry, U. S. Dept. of Agriculture, "The Crown-Gall and Hairy-Root Diseases of the Apple Tree," 1905.

The object of all grafting should be to bring about as rapid a union between the two grafted parts as possible, with the smallest possible period during which an open wound is allowed to remain into which disturbing factors may enter. With this in mind, a number of experiments were made during the past year, the specific objects of which were to confine the formation of callus as far as possible to the spaces between the root and scion pieces, thereby bringing about a closer and more effective union and reducing the chances for the entrance of possible disturbing factors.

It is intimated that the formation of the hard and soft types of apple crown-gall may be due either to a proliferation of callous tissue in cases where an uneven union is taking place and where the callus has had a chance to grow out laterally in an unrestricted manner, or to fungi, bacteria, or unfavorable soil or atmospheric conditions. Whatever the cause, the making of a perfect union in the shortest possible time may serve to prevent the trouble almost wholly if the first explanation given be the cause, and at least largely remove the danger of a possible infection if the second explanation is found to hold good.

ACCOUNT OF EXPERIMENTS.

In order to confine the formation of the callus, a number of grafts were wrapped with various materials during the winter of 1904–5. The wrapping idea is no new one, because cloth and paper were used by nurserymen many years ago in connection with various types of root and top grafting. At the present time cloth and paper are used very little, because the system of thread wrapping will give a larger number of grafts in a given period of time. The materials used in our experiments were cloth, thin sheet rubber (dental rubber), and waxed paper. In addition to this, grafts were made with plain thread and waxed thread, and some grafts were wrapped with plain thread and afterwards the whole union was covered with grafting wax. One series of grafts was made without any wrapping of cloth or thread whatever, the pieces being simply fitted together with care. All grafts made were of the type known as tongue or whip grafts. The work was done by an expert, so that all of the grafts may be considered as especially well made. No. 1 Kansas roots and a selected lot of scions of the following varieties were used: Winesap, York Imperial, Wealthy, Missouri, and Northern Spy. The grafts were made in February, 1905. They were stored in chopped excelsior for about six weeks, were then planted in eight different localities in Missouri, Illinois, Iowa, Nebraska, Kansas, and Arkansas, and given the usual cultivation during the summer. All showed a fair stand in November, 1905. Some of the grafts were dug in November and December, 1905, one-third of the total number planted in five test plats in four States being dug. The results obtained are given in another chapter.

MANNER OF WRAPPING.

The manner in which the wrapping was made and the material used may be briefly described as follows :

Cloth.—The cloth used was a cheap black calico of the poorest grade obtainable in the market. This was torn into strips 1 inch wide and 4 or 5 inches long. After the graft was made, one end of the cloth was dipped for one-half inch into hot melted grafting wax. Starting with the other end, the cloth was then wrapped tightly around the scion and the free waxed end pressed down. This completed the operation.

Rubber.—The rubber used was of a quality similar to dental rubber, which is also frequently used for insulating wires. It was bought in rolls 1 inch wide, and was cut off in such lengths as were necessary to completely envelop the union. The rubber was usually wrapped so as to go around the union twice, and the free end was fastened with rubber cement applied with a brush.

Waxed paper.—Sheets of ordinary unglazed printers' paper were waxed on one side by coating them with hot grafting wax applied with a paint brush. They were then cut into inch strips, 10 to 20 sheets being cut at one time, and these again into strips about 4 or 5 inches long. One paper strip was then wrapped around the union, the waxed side toward the graft, the free end being stuck down by pressing it on.

Plain thread.—The thread used for the ordinary grafts was a machine cotton, No. 9.

Waxed thread.—The thread used was a machine cotton, No. 28. This thread was soaked in hot grafting wax until thoroughly penetrated and was then allowed to drain while hot.

Plain thread with union waxed.—These were ordinary grafts made with plain thread, wrapped as previously described, and then coated with melted grafting wax nearly at the point of hardening.

GRAFTS LEFT UNWRAPPED.

The grafts left without wrapping of any kind were made with special care, so that when the roots and scions were joined they remained firmly united.

RESULTS OF WRAPPING.

After digging the grafts, a careful examination of the various series was made to determine the effect of the wrapping on the union and on the presence or absence of crown-gall formation.

The following table shows the number of apple trees dug, the character of the wrapping, and the number and percentage of smooth trees and rough trees, the latter class including all trees which were found to have crown-gall, irregular callus, or hairy-root formations:

TABLE I.—*Comparison of smooth trees and rough trees resulting when different methods of grafting were used.*

Kind of wrapping.	Total number.	Smooth trees.		Rough trees.	
		Number.	Per cent.	Number.	Per cent.
Rubber	675	584	86.5	91	13.5
Cloth	709	604	85.1	105	14.9
Waxed paper	671	474	70.6	197	29.4
Plain thread	645	442	68.5	203	31.5
Waxed thread	675	430	63.7	245	36.3
Plain thread with union waxed	402	178	44.2	224	55.8
Unwrapped	569	312	54.8	257	45.2

Two series of facts may be deduced from this table—

(1) The effect of the various kinds of wrapping on the smoothness of the union.

(2) The effect of wrapping on the presence or absence of crown-gall formations.

EFFECT UPON THE UNION.

Some brief notes on the effect of the wrapping on the union follow. By a smooth graft is meant one which shows no uneven or irregular masses of callus. In the smooth grafts all parts are firmly united, so that no ridge or roughness is felt when the union is rubbed with the fingers. The grafts were graded with the greatest care.

Cloth.—When the grafts were planted in the spring the cloth was usually intact. When dug in the autumn it had almost entirely rotted away on all grafts. The union which resulted under the cloth was generally smooth and very even. In many cases it was difficult to detect the original position of the scion and root parts. The cloth had evidently remained in position long enough to thoroughly confine the callus to the spaces between the wounded surfaces.

Rubber.—When the grafts were planted the rubber wrapping was wholly intact. When dug the rubber was still found around the union in the majority of cases. It had, however, exerted no injurious effect, because, as the young trees had grown in diameter, the rubber had expanded. The roots had frequently punctured the rubber freely. In other words, the rubber had in no way retarded the growth. The unions formed under the rubber were smooth and even; in fact, they were the most perfect of all those formed in the experiment. The rubber covering was practically waterproof. So perfect were the unions that in many cases it was possible to detect the line of demarcation between the root and scion only by the difference in color.

Waxed paper.—When planted in the spring the waxed paper had not rotted, but it had a tendency to become unrolled, due probably to too much oil in the wax. When dug in the autumn the paper had mostly disappeared. The grafts showed many smooth trees, but the percentage was not nearly so large as in the case of those wrapped with rubber or cloth. Attention should be called to the fact that in all grafts where wax was used the wax itself seemed to exert an unfavorable effect on the union, and the writers are inclined to discourage its use wherever it comes into direct contact with wounded surfaces.

Plain thread.—When planted in the spring the plain thread had in many instances entirely rotted away. The grafts when dug showed many callous proliferations. The percentage of smooth grafts was low when compared with rubber or cloth wrappings. The results were about as good as those secured by the use of waxed paper wrapping and a little better than those obtained with waxed thread.

Waxed thread.—When the grafts were planted the waxed thread was intact. When dug in the autumn the grafts showed from 6 to 8 per cent with knots caused by the pressure exerted by the thread, which had not rotted away because the wax protected it more or less. The percentage of smooth trees aside from this was almost the same as for the plain thread. No perceptible advantage appeared to be gained by the use of waxed thread as compared with plain thread.

Plain thread with union waxed.—At the time of planting it was noted that the wax had in many instances penetrated between the surface of the two pieces. The callus had formed in irregular masses, there being nothing to confine it. It furthermore appeared as if the wax had exerted the unfavorable effect already referred to in connection with the use of waxed paper. When dug the trees in the majority of instances showed thread knots, due no doubt to the fact that the wax had retarded the rotting away of the thread. The unions were usually rough. The unfavorable effect ascribed to the wax was evident not only in the immediate wound areas, but also all along the bark on both scion and root pieces, wherever the wax came in contact with the tissue.

Unwrapped grafts.—The grafts with no wrapping showed the excessive development of callus more than any others. However, many of the resulting trees when dug in the autumn showed fairly good unions. The grafts as a whole fell below the wrapped ones in the number of smooth trees. There were more deficient trees in this lot, with the possible exception of those waxed over, owing to defective unions and failures to form a union.

EFFECT ON CROWN-GALL FORMATION.

As indicated in the introduction, one of the objects of the experiment was to determine whether by wrapping grafts it would be possible to reduce the number of trees affected with crown-gall. In the following table the total number of trees dug is given ; also the kind of wrapping, and the number and percentage of smooth trees, crown-gall trees, and hairy-root trees :

TABLE II.—*Comparison of smooth trees and trees affected with crown-gall and hairy-root, resulting when different methods of grafting were used.*

Kind of wrapping.	Total number.	Smooth trees.		Crown-gall trees.		Hairy-root trees.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Rubber	675	584	86.5	65	9.6	26	3.9
Cloth	709	604	85.1	70	9.8	35	5.1
Waxed paper	671	474	70.6	168	25.0	29	4.4
Plain thread	645	442	68.5	130	20.2	73	11.3
Waxed thread	675	430	63.7	182	27.0	63	9.3
Plain thread with union waxed	402	178	44.2	193	48.1	31	7.7
Unwrapped	569	312	54.8	200	35.2	57	10.0

A study of this table will show that the wrapping reduced the number of crown-gall trees very materially, but the results given should be considered as preliminary and the figures as relative rather than absolute. Only a small percentage of the trees under test have so far been dug. The remainder will be dug after one or two years' growth.

The most effective wrapping, so far as the true crown-gall is concerned, was that made of rubber (86.5 per cent of smooth trees). followed closely by cloth (85.1 per cent of smooth trees). The cloth wrapping, however, shows the highest percentage of smooth trees per 100 grafts planted, when not only the crown-gall but also the hairy-root are considered. The difference is very slight, however. The other wrappings show less favorable results, least of all in the case of the grafts wrapped with plain thread and covered with grafting wax (44.2 per cent of smooth trees), followed closely by those with no wrapping whatever (54.8 per cent of smooth trees).

RECOMMENDATIONS.

From the results so far obtained, the use of either cloth or rubber as material for wrapping apple grafts is recommended. Owing to the expense involved in the use of rubber, cloth will be found the most desirable, and in most cases will probably give results fully as satisfactory as rubber. The writers strongly advise against the wrapping of grafts with thread and subsequently waxing the grafts.

SUGGESTION TO NURSERYMEN.

The results obtained from the experimental plats having shown that the wrapping has materially reduced the number of crown-gall and other types of rough trees, it will be very desirable to test these results on a larger scale. The grafts in these experiments were all made with the greatest care, and it would seem probable that the number of smooth trees obtained was therefore larger than might be the case where commercial grafts are made. The latter are usually not fitted with as much care, either with respect to size of scion and root pieces or with regard to an even and close union in the freshly made graft. It is therefore urged that nurserymen generally test the wrapping of their grafts this winter, either with rubber or cloth, after the manner previously described.

Care should be taken in setting out grafts with different kinds of wrapping to treat them in the same manner, that is—

(1) Use the same variety of scion.
(2) Use the same stock of roots.
(3) Make the grafts at the same time.
(4) Plant the grafts on the same date.
(5) Plant in the same field or at least on similar soil.
(6) Cultivate all grafts alike.

Where such tests are made, it is requested that the Bureau of Plant Industry be informed, so that all the experiments may be compared.

It may prove of interest to estimate the total number of smooth and rough trees to the acre which would result from the use of various wrappings, estimating 18,000 grafts to the acre and using as a basis the percentages of such trees obtained in the tests described in these pages. By smooth trees are meant trees free from crown-gall and other diseases; by rough trees, trees affected with true crown-gall, hairy-root, or manifestations of other diseases at or near the point of union. This estimate has been attempted in the following table, which should be regarded only as suggestive, however. The results are averaged from five identical plats in four different States, containing about 9,000 grafts.

TABLE III.—*Estimate of the number of smooth trees and rough trees which can be raised on an acre of land by using various methods of grafting.*

Wrapping.	Smooth trees.	Rough trees.	Total trees.
Rubber	12,600	1,980	14,580
Cloth	12,960	2,340	15,300
Waxed paper	10,260	4,320	14,580
Plain thread	9,540	4,320	13,860
Waxed thread	9,360	5,220	14,580
Plain thread with union waxed	3,780	4,860	8,640
Unwrapped	6,660	5,580	12,240

SUMMARY.

(1) The crown-gall disease of apple trees usually appears at or near the union of the scion and root piece.

(2) The crown-gall disease may be due to an excessive growth of callus, or to an infection of fungi, bacteria, or other agencies at or near the union.

(3) Protection of the graft at the union will serve to induce a better union and may also aid in keeping out disturbing factors.

(4) In making grafts care should be taken to use root and scion pieces of as nearly the same size as possible.

(5) Grafts wrapped with cloth and with rubber yielded 85.1 per cent and 86.5 per cent of smooth trees, respectively.

(6) Ordinary thread grafts yielded 68.5 per cent of smooth trees; plain thread grafts with the union waxed, 44.2 per cent; grafts with no wrapping, 54.8 per cent.

(7) It is recommended that apple grafts be wrapped with cloth or rubber.

○

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART III.

B. T. GALLOWAY, *Chief of Bureau.*

GARLICKY WHEAT.

BY

J. W. T. DUVEL,
ASSISTANT IN THE SEED LABORATORY.

ISSUED APRIL 5, 1906.

1862 1889

239414 b
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

Page.
Introduction 5
Wheat containing garlic 5
Experiments in separating garlic from wheat 6
    Lot A 7
    Lot B 8
    Lot C 9
The total cost of drying and cleaning garlicky wheat 10
    The net cost of removing garlic 12
The effect of the drying on the milling qualities of the grain 12
The effect of the drying on the vitality of the wheat 13
Machinery used for drying and cleaning 14
Summary 14
Description of plates 16

ILLUSTRATIONS.

Plate I. Wheat kernels and the aerial bulblets of wild garlic. Natural size........ 16

II. Figs. 1, 2, and 3. One-pound samples of garlicky wheat, Lots A, B, and C, respectively, as received; the quantity of garlic in 1-pound samples when received and the amount of garlic remaining in 1-pound samples after drying and cleaning 16

B. P. I.—204.

GARLICKY WHEAT.

INTRODUCTION.

Wild garlic, *Allium vineale* L., was introduced into the United States from Europe considerably more than a century ago. Since its introduction it has made a slow but steady advance, and is now found growing more or less abundantly throughout the greater part of West Virginia, Virginia, Maryland, Delaware, Tennessee, North Carolina, the northern part of South Carolina, the southern part of Pennsylvania, New Jersey, and Connecticut, and locally in almost every State east of the Mississippi River. In all places where it has become well established it is a veritable pest to farmers, millers, grain dealers, and dairymen.

Wild garlic is one of the worst weeds to eradicate after it has once gained a foothold, being propagated by underground bulbs, aerial bulblets, and in some sections by seeds.

WHEAT CONTAINING GARLIC.

The presence of wild garlic in the grain fields of the central eastern States and in other sections where it is locally abundant has caused a very great loss to agriculture. Farmers have been obliged to sell their garlicky wheat at greatly reduced prices, principally because foreign markets will not buy it except at a low price, and millers as a rule refuse to handle it, for they have been able to grind garlicky grain only at a much increased cost. The garlic bulblets gum the rollers, necessitating the stopping of the mills and the washing of the rollers before the grinding can be resumed. The frequency with which the washing must be done depends on the quantity of garlic present. In extreme cases the washing must be repeated every two or three hours, the operation requiring from ten to fifteen minutes for each set of rollers.

Furthermore, flour made from wheat mixed with garlic bulblets is of inferior quality, as bread made from such flour has the garlic odor so disagreeable to most people. This is especially noticeable if the bread is eaten warm. Moreover, on boards of trade, wheat containing garlic bulblets in considerable quantity is graded as "Rejected," and is then sold only on sample. Wheat of this character is generally sold at a price ranging from 20 to 40 per cent lower than No. 2 Red. However, if the garlic bulblets are present only in comparatively small quantity (usually less than one-fourth of 1 per cent) it may pass as No. 2 Red, depending largely on the other foreign substances present and the amount of water in the grain.

At present there are no available data showing definitely the extent of the loss due to the presence of garlic in grain; but in wheat alone this loss is known to be very great. In many sections the growing of wheat has been almost wholly abandoned as a result of the reduced price at which garlicky wheat must be sold. An annual loss of $1,500,000 is undoubtedly a very conservative figure. It has been estimated by members of the Chamber of Commerce of Baltimore that 60 per cent of the wheat grown in that section of the United States contains more or less garlic. The three States in which garlic does the greatest injury to the wheat crop are Maryland, Virginia, and Tennessee. The average yield of wheat from these three States during the five years from 1900 to 1904, inclusive, was just short of 29,000,000 bushels. Allowing that 50 per cent of this wheat contains garlic, we have 14,500,000 bushels of garlicky wheat in these three States alone. But granting that only one-half of this amount contains garlic in sufficient quantity to throw it out of grade, we still have 7,250,000 bushels of wheat which must be sold at a greatly reduced price. A reduction of only 15 cents per bushel means more than a million dollars annually to the farmers of Maryland, Virginia, and Tennessee. The members of a prominent firm of grain exporters in Baltimore state that the depreciation for the Maryland crop alone, which amounts to about 12,000,000 bushels annually, will be fully 5 to 10 cents per bushel, or an equivalent of $600,000 to $1,200,000. A large quantity of garlicky wheat, however, does not get into the elevators, being fit only for feeding purposes. Mr. R. L. Wells[a] states that, in Tennessee, wheat containing garlic bulblets has been sold as low as 15 cents per bushel to feed stock.

EXPERIMENTS IN SEPARATING GARLIC FROM WHEAT.

The presence of the aerial bulblets of wild garlic in wheat has always been objectionable, principally because of the extreme difficulty of separating them from the wheat. While some of the lighter, immature bulblets can be blown out by a good fanning mill, the greater quantity are of practically the same size and weight as the wheat kernels. Plate I shows wheat kernels and the aerial bulblets of wild garlic of natural size. This similarity in size and shape makes it impossible to separate them during the autumn or early winter by the use of the ordinary cleaning machinery usually found in the majority of flour mills and elevators, i. e., by screening and fanning. If the bulblets are allowed to freeze, they afterwards become dry and are then quite readily blown out, but this is not always practicable.

---

[a] The Wild Onion, Bulletin, Tennessee Agricultural Experiment Station, July, 1895.

In view of this fact experiments were undertaken in June, 1905, in order to ascertain whether the mixture of garlic and wheat could not be dried artificially, thereby reducing the weight of the bulblets to such an extent that they could be satisfactorily removed as soon as the grain is ready for market. The detailed results of these experiments[a] are given in the following pages.

LOT A.

Lot A consisted of approximately 44 bushels of "rejected" wheat furnished by the Baltimore Chamber of Commerce. When received it contained 16.55 per cent of water and 2.17 per cent of garlic. The amount of foreign seed and chaff present was not determined. The value of this wheat was placed at 65 or 70 cents a bushel.

Experiment No. 1.—A portion of this wheat was dried in the small grain drier of the Seed Laboratory at a maximum temperature of 136° F. for two hours. During this time the moisture content of the grain was reduced from 16.55 per cent to 9.5 per cent, or from 2½ to 4½ per cent less than good American wheat normally contains. But this degree of drying proved insufficient, as 0.28 per cent of garlic still remained in the sample after a preliminary cleaning. This same lot of wheat was therefore dried for an additional half-hour and the moisture content was reduced to 8.94 per cent.

Experiment No. 2.—Another portion of seed from Lot A was dried a few days later for nearly four hours, the maximum temperature reading 140° F. At the termination of the drying a moisture determination of a sample of this wheat showed only 5.87 per cent of water.

The wheat from experiments Nos. 1 and 2 was then mixed and cleaned, and the average percentage of water in the mixed sample was found to be 7.41 per cent. After cleaning, an analysis of this wheat showed that the amount of garlic had been reduced from 2.17 to 0.05 per cent, 97.6 per cent of the garlic having been removed. Plate II, figure 1, shows a 1-pound sample of this wheat as received, the quantity of garlic in 1 pound when received, and the quantity of garlic remaining in 1 pound after drying and cleaning.

Concerning this lot of wheat the secretary of the Baltimore Chamber of Commerce wrote as follows:

> The wheat which you cleaned and returned was the source of a great deal of interesting comment upon the floor of the chamber, and the general idea is that a very vast change was accomplished by running it through the drier. The sample sent originally was of such low

---

[a] Acknowledgments are due to the members of the Baltimore Chamber of Commerce and to Mr. Walter Roberts, of Alexandria, Va., and Mr. E. H. Darby, of Seneca, Md., who kindly supplied the garlicky wheat for these experiments.

and inferior grade as to prohibit it from going into the elevators, and the drying and cleaning to which it was subjected made it No. 2 Red, the contract grade, a difference in value of fully 17 cents per bushel.

An increase of 17 cents per bushel was equivalent to 24.6 per cent of the value of this wheat before drying and cleaning.

LOT B.

A second sample of approximately 38 bushels of "rejected" wheat furnished by Mr. Walter Roberts, Alexandria, Va., contained 0.56 per cent of garlic and 15.08 per cent of water and weighed only 57.5 pounds per bushel.

The lot was divided into three parts for treatment, as follows:

Experiment No. 3.—In this test the drying was continued for three hours, the temperature of the air varying from 153° to 158° F. and the temperature of the wheat from 117° to 155° F. The moisture was reduced from 15.08 to 7.92 per cent. The weight per bushel was increased from 57.5 to 59.25 pounds on drying and to 60.6 pounds after cleaning. The quantity of garlic was reduced to 0.05 per cent, the same as the combined results of experiments Nos. 1 and 2.

Experiment No. 4.—The period of drying in this experiment extended over three and one-half hours, the temperature of the air being the same as in experiment No. 3, 153° to 158° F., the temperature of the wheat gradually increasing from 95° F. at the end of the first half-hour to 145° F. During the three and one-half hours' drying the water content of the wheat was reduced to 6.88 per cent and the weight per bushel increased to 59.5 pounds. After cleaning, the weight per bushel was increased to 60.7 pounds and the quantity of garlic reduced from 0.56 per cent to 0.06 per cent. Plate II, figure 2, shows a 1-pound sample of this wheat as received, the amount of garlic in 1 pound when received, and the amount of garlic remaining in 1 pound after drying for three and one-half hours and cleaning.

Experiment No. 5.—The last portion of Lot B was dried for two and three-fourths hours, the temperature of the wheat reaching 122° F. in three-quarters of an hour, and 138° F. after one hour, which temperature was maintained for one-half hour, gradually decreasing during the last one and one-quarter hours to 117° F., when the experiment was concluded. The moisture content of the wheat was reduced from 15.08 to 8.48 per cent and the weight per bushel raised from 57.5 to 58.6 pounds. After cleaning, the weight per bushel was 60 pounds and the garlic present 0.07 per cent.

After drying and cleaning, the wheat from Lot B graded No. 2 Red, having at that time a value of 85 cents per bushel. As in its original condition the wheat was purchased for 55 cents per bushel, the drying and cleaning increased its value 54.5 per cent.

LOT C.

A consignment of approximately 30 bushels of "rejected" wheat, containing 2.04 per cent of garlic, 16.2 per cent of water, and weighing only 56.5 pounds a bushel, was lent to the Department of Agriculture by Mr. E. H. Darby, of Seneca, Md.

This lot of wheat was divided into two parts and treated as experiments Nos. 6 and 7.

Experiment No. 6.—This wheat was subjected to an air temperature of 113° F. for one hour and of 154° F. for two hours, the maximum temperature of the grain for the last half hour being 149° F. The moisture content was reduced from 16.2 per cent to 8.2 per cent. The weight per bushel was raised to 57.8 pounds after drying and 60.6 pounds after cleaning, and the amount of garlic was reduced to 0.17 per cent.

Experiment No. 7.—This experiment continued for three hours, as in experiment No. 6, but the temperature of the air current decreased gradually from 146° to 122° F., the maximum temperature of the grain being 131° F. Samples taken at the termination of the experiment showed a moisture content of 8.83 per cent. The weight per bushel was increased to 57.5 pounds after drying and 60.2 pounds after cleaning. Plate II, figure 3, shows a 1-pound sample of this wheat as received, the amount of garlic in 1 pound when received, and the amount of garlic remaining in 1 pound after drying for three hours and cleaning.

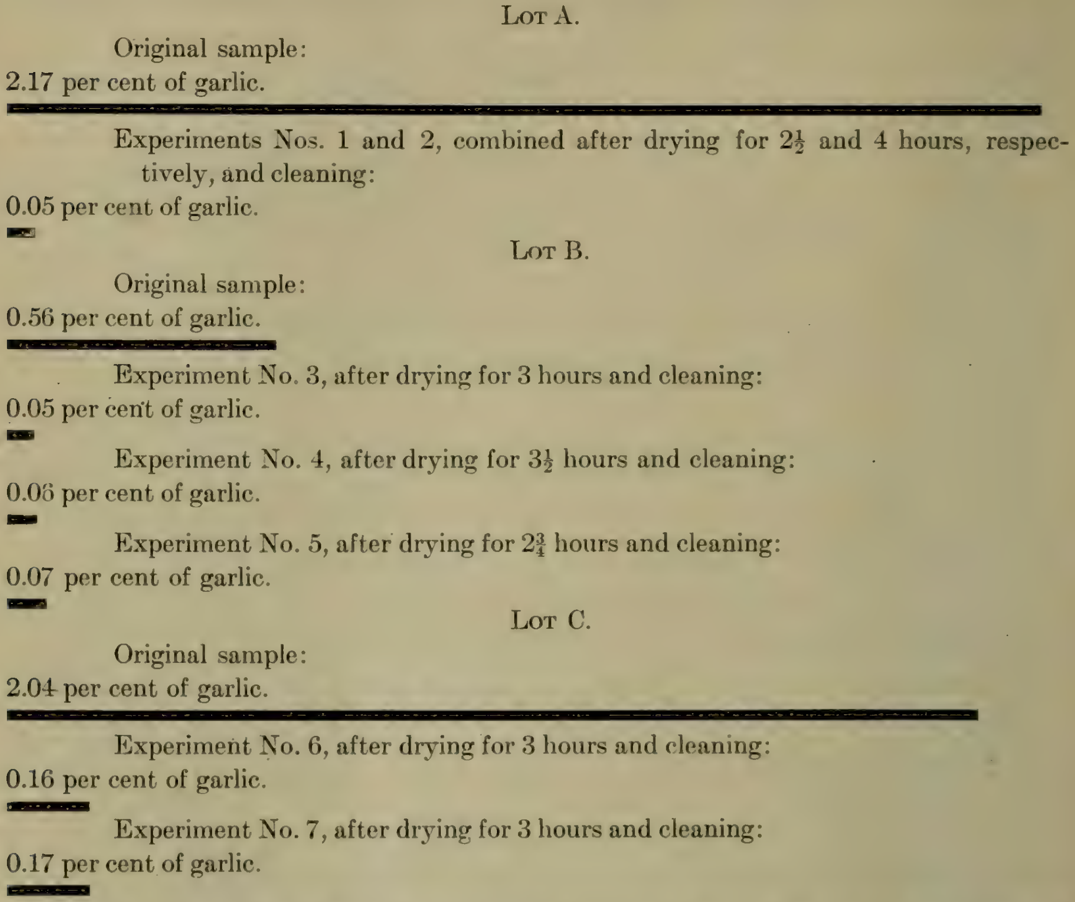
A sample of this cleaned wheat was examined by the chief inspector of the Baltimore Chamber of Commerce and graded as No. 2 Red, giving it a value of 84.5 cents per bushel. The highest price offered for the original lot of wheat was 60 cents per bushel. The removing of the garlic and the cleaning consequently enhanced the value 40.8 per cent.

In experiments Nos. 6 and 7 the drying was not continued quite long enough for the best results, although the quality of the wheat was raised to "contract" grade. At temperatures from 150° to 158° F. the drying should continue for two and one-half to three hours, or until the moisture content of the wheat is reduced to about 8 per cent.

In none of the experiments was it possible to remove all of the garlic, but in every case the quantity was reduced considerably more than was necessary to make the wheat grade as No. 2 Red. Moreover, the quantity of garlic present after the cleaning was not considered sufficient to interfere with the milling of the wheat or to injure the quality of the flour.

The following diagrammatic figures show the relative quantity of garlic in the wheat before and after treatment:

Percentages, by weight, of garlic in wheat, Lots A, B, and C, before and after drying and cleaning



Garlic bulblets as found in wheat contain from 35 to 70 per cent of water, while the water content of fresh garlicky wheat usually varies from 15 to 20 per cent. During the drying the amount of water in the wheat is decreased, but at the same time the kernels become more compact and the specific gravity is increased, as is shown by the weight per bushel before and after drying. On the other hand, the specific gravity of the garlic bulblets is lowered by the drying. The outer membranous coverings of the bulblets remain distended and the shrinkage takes place in the inner portion, thus leaving a small air space between the bulb proper and the outer protecting layers. This increased air space, together with the decreased weight due to the loss of water, makes it possible to separate most of the bulblets from the wheat by ordinary cleaning machinery.

THE TOTAL COST OF DRYING AND CLEANING GARLICKY WHEAT.

The total cost, including the shrinkage, of drying and cleaning any given lot of wheat for the removal of garlic depends on four factors: (1) The amount of garlic removed; (2) the amount of chaff and other foreign substances, aside from the garlic, removed; (3) the percentage of water removed from the wheat; (4) the cost of operating the machinery.

The amount of garlic removed.—In the experiments with the three lots of wheat herein described practically all of the garlic was removed, and this must be considered as a loss in weight. The average loss for each of the three lots of wheat due to the removal of garlic was 2.12 per cent, 0.50 per cent, and 1.88 per cent for Lots A, B, and C, respectively.

The amount of chaff and other foreign substances, aside from the garlic, removed.—The loss in weight due to the cleaning, aside from the quantity of garlic, depends entirely upon the amount of light, immature wheat, chaff, and other foreign substances removed. This loss bears the same ratio for any lot of wheat. Consequently, strictly speaking, this additional decrease in weight can not be considered as an extra expense in the treatment of garlicky wheat. Moreover, the quantity of foreign substances present has an important bearing on the grading of the grain.

The following summary shows the percentages of screenings, including the garlic, obtained from the wheat treated as experiments Nos. 3, 4, 5, 6, and 7:

Experiment No. 3 gave 611 pounds of clean wheat and 28 pounds, or 4.4 per cent, of screenings. Experiment No. 4 gave 548.5 pounds of clean wheat and 15.5 pounds, or 2.8 per cent, of screenings. Experiment No. 5 gave 736.5 pounds of clean wheat and 26.5 pounds, or 3.4 per cent, of screenings. The average percentage of screenings from experiments Nos. 3, 4, and 5 (Lot B) was 3.54 per cent. Deducting from this the amount of garlic removed from Lot B, 0.50 per cent, there is left 3.03 per cent, the proportion of immature wheat, chaff, and other foreign substances removed.

In experiments Nos. 6 and 7, 1,536 pounds of dried wheat gave 135 pounds of screenings, an equivalent of 8.8 per cent, of which 1.88 per cent was garlic, leaving 6.92 per cent of immature wheat, chaff, and other foreign substances removed.

The percentage of water removed from the wheat.—Garlicky wheat almost invariably contains a high percentage of water, and the greatest loss in weight is probably due to the liberation of water during the drying process. In these experiments the quantity of water was reduced from 16.55 per cent, 15.08 per cent, and 16.20 per cent to an average of 7.41 per cent, 7.76 per cent, and 8.52 per cent for Lots A, B, and C, respectively. In order that the garlic may be removed satisfactorily it is necessary to reduce the water content to approximately 8 per cent, which is from 4 to 6 per cent less than No. 2 Red wheat normally contains. However, the dried wheat will again absorb water from the atmosphere, and after the lapse of a few days the water content will be practically the same as that of air-dried wheat. Likewise the clean, dried wheat can be mixed with any garlic-free lot of wet wheat and the grade of the latter improved in this way. For this reason, only the difference between the water content of the wet garlicky wheat and that of No. 2 Red, which averages about 13 per cent during the first few months after harvesting, should be considered as actual loss in weight due to drying. On this basis the loss due to the removal of water was 3.55 per cent for Lot A, 2.08 per cent for Lot B, and 3.20 per cent for Lot C.

The cost of operating the machinery.—The cost of the actual drying and cleaning alone is very small. With the low pressure boilers available for use with the small grain drier in the Bureau of Plant Industry the maximum temperature possible is only 158° F. At this temperature it is necessary to continue the drying for from two and one-half to three hours in order that the weight of the garlic may be sufficiently reduced so that it can be removed. With the high pressure boilers such as are found in most grain elevators and flour mills an air temperature of 170° to 180° F. can be readily maintained, at which temperature the time factor can be greatly reduced. By careful calculation it is believed that the actual cost of operating the machinery for the drying and cleaning should not exceed one-half cent per bushel.

This factor, however, will vary with the capacity of the drier and the number and size of the other kinds of machinery being operated simultaneously by the same boilers.

THE NET COST OF REMOVING GARLIC.

To ascertain the net cost of removing garlic bulblets from wheat in order to bring it up to "contract" grade, only the following items need be taken into consideration: (1) The cost of operating the machinery; (2) the loss in weight due to the quantity of garlic actually removed, and (3) the difference in the amount of water normally contained in good air-dried wheat, which is not far from 13 per cent, and the amount of water in the garlicky wheat before it goes into the drier. On this basis the cost of drying and cleaning the garlicky wheat discussed in the foregoing pages was 6.3 per cent, 3.2 per cent, and 5.7 per cent, or an equivalent of 5½ cents, 2¾ cents, and 4⅘ cents per bushel for lots A, B, and C, respectively, as governed by the prices current at that time.

THE EFFECT OF THE DRYING ON THE MILLING QUALITIES OF THE GRAIN.

No flour was made from any of the wheat after drying and cleaning; but the consensus of opinion of the majority of the millers to whom samples of the dried wheat were submitted was that the milling qualities of the wheat had not been injured by the drying. Such wheat, however, is not fit for milling until it has absorbed water from the atmosphere, or has been mixed with damp grain, or steamed, in order to toughen the bran. If the milling is attempted while the wheat is exceptionally dry, the bran will be easily broken, resulting in the production of coarse, dark flour.

THE EFFECT OF THE DRYING ON THE VITALITY OF THE WHEAT.

The objection has frequently been made that the high temperature ordinarily used in the commercial drying of grain will destroy the germinating power. In the majority of cases the vitality of the grain after drying is of little importance, as such grain is seldom used for sowing or planting. The foregoing objections, however, are not well established, as the vitality of grain is not injured by drying in commercial grain driers at the temperatures commonly employed.

The grounds for the belief that temperatures as high as 140° to 175° F. for periods of short duration will destroy the vitality of grains are based on laboratory tests in which no provision was made for the circulation of air. Under such conditions the life-giving principles are readily destroyed, especially when considerable moisture is present. But when the drying is done in such a way that the moisture liberated will be readily carried away, as in commercial grain driers, there is little danger of destroying the vitality of the grains, even though the duration of drying be several times greater than that given for the foregoing experiments.

The following table shows the effect of the drying on the germinating capacity of the samples of garlicky wheat from lots B and C, already discussed:

Percentages of germination of wheat from lots B and C before and after drying.

Sample mark.	Duration of drying.	Temperature of air current in drying.	Maximum temperature of wheat.	Water content of wheat.	Germination.
	Hours.	*Degrees F.*	*Degrees F.*	*Per cent.*	*Per cent.*
Original sample				15.08	80
Experiment No. 3	3	153–158	155	7.92	83.5
Experiment No. 4	3½	153–158	145	6.88	85
Experiment No. 5	2¾	155–108	138	8.48	79.5
Original sample				16.20	82
Experiment No. 6	2½	113–154	149	8.20	83
Experiment No. 7	3	146–122	131	8.83	85

With but a single exception the percentages of germination were higher after the drying than before, and such is generally true. In all cases the germination was low, due to the damaged condition of the grain when received.

While the tests made are few in number, the results given in the foregoing table are sufficient to show that a good quality of garlicky wheat can be dried and afterwards cleaned and used for sowing with entirely satisfactory results. The garlic bulblets, as found in wheat, contain from 35 to 70 per cent of water. With this high percentage of water the greater quantity of the bulblets are partially cooked or scalded during the drying process, thus rendering growth impossible.

MACHINERY USED FOR DRYING AND CLEANING.

The drying was done in a small grain drier. In the absence of a good fanning and screening machine for the larger grains, the wheat was first run through a fanning mill specially constructed for cleaning clovers, alfalfa, and timothy. The greater quantity of the garlic was blown out, but many of the larger bulblets could not be removed in the absence of screens, and for this reason the wheat, for the final cleaning, was put through a "shaker" such as is commonly used for cleaning rice.

It is not desired to place any special emphasis on the particular machinery used for these experiments. Any of the good commercial driers with any good cleaning machinery should give satisfactory results.

SUMMARY.

The presence of the aerial bulblets of wild garlic in a large quantity of the wheat grown in the central eastern United States causes a great depreciation in its value. The loss to agriculture from this cause alone is very conservatively estimated at more than $1,500,000 annually.

The wheat kernels and the garlic bulblets are very similar in size and weight, which makes their separation by the methods ordinarily in use next to impossible as long as they are fresh.

If wheat containing garlic is artificially dried, the wheat kernels increase in specific gravity and the garlic bulblets decrease in specific gravity, so that practically all of the latter can be removed by good cleaning machinery.

Garlicky wheat is usually wet, often containing as much as 20 per cent of water, and the drying should be continued until the moisture is reduced to approximately 8 per cent.

In estimating the total cost of the treatment of a lot of garlicky wheat, only the amount of garlic removed, the excess of moisture above that which good No. 2 Red wheat usually contains, and the cost of operating the machinery need be considered. The cost of removing the chaff, immature wheat, etc., is the same as for the cleaning of any sample of wheat free from garlic.

The commercial drying of wheat in a good commercial grain drier does not injure its vitality, while most of the garlic bulblets are killed, owing to the higher percentage of water in the latter.

It has not been definitely determined, but the more general opinion is that the drying does not injure the milling qualities of the wheat.

Any of the good commercial grain driers, together with any good wheat-cleaning machinery, should give satisfactory results.

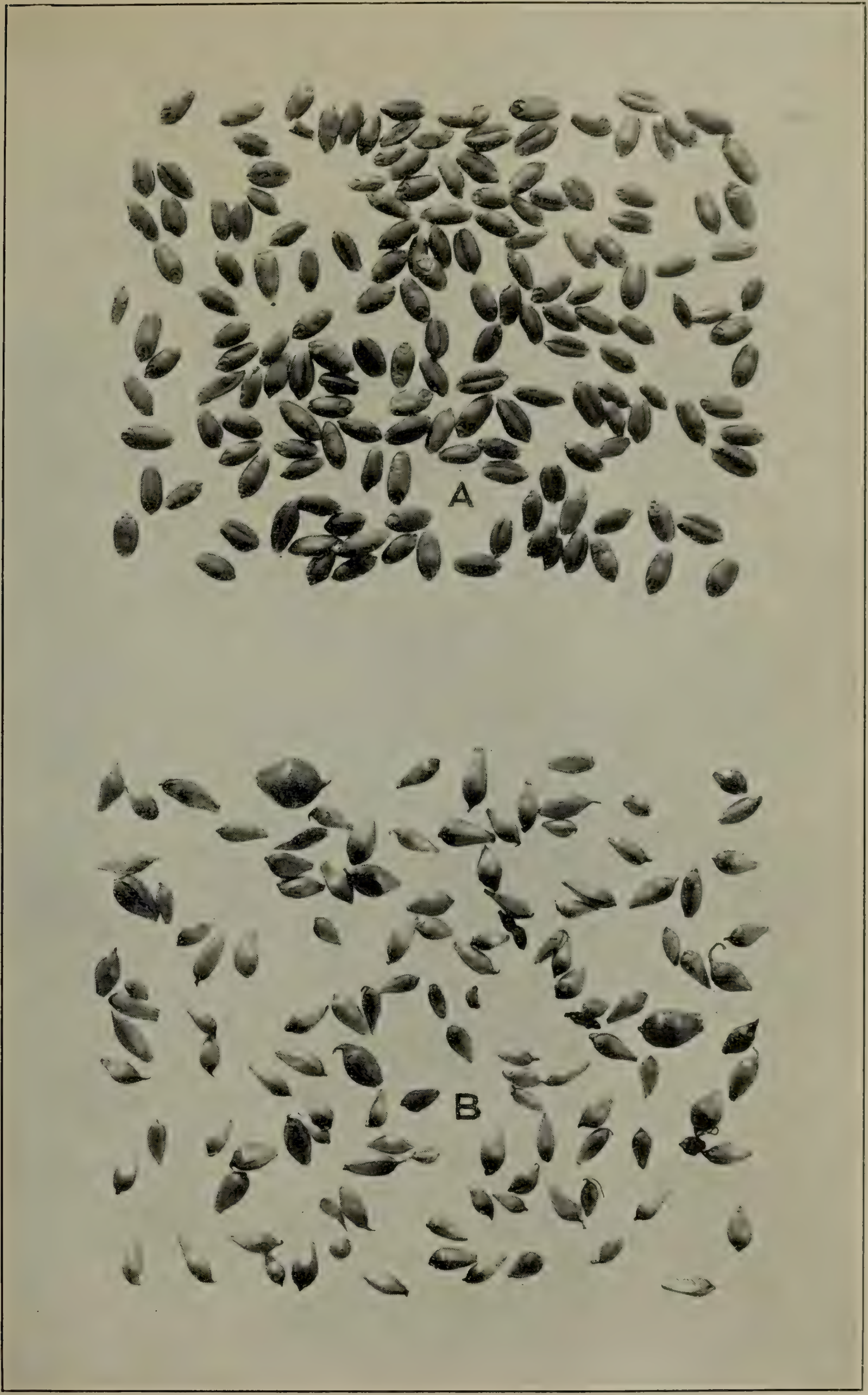
PLATES.

DESCRIPTION OF PLATES.

PLATE I. Wheat kernels and aerial bulblets of wild garlic. (Natural size.)

PLATE II. Fig. 1.—*A*, 1-pound sample of garlicky wheat, Lot A, as received; *B*, amount of garlic in 1-pound sample when received, 2.17 per cent; *C*, amount of garlic remaining in 1-pound sample after drying and cleaning, 0.05 per cent. Fig. 2.—*A*, 1-pound sample of garlicky wheat, Lot B, as received; *B*, amount of garlic in 1-pound sample when received, 0.56 per cent; *C*, amount of garlic in 1-pound sample after drying and cleaning, 0.06 per cent. Fig. 3.—*A*, 1-pound sample of garlicky wheat, Lot C, as received; *B*, amount of garlic in 1-pound sample when received, 2.04 per cent; *C*, amount of garlic remaining in 1-pound sample after drying and cleaning, 0.16 per cent.

O



WHEAT KERNELS (A) AND AERIAL BULBLETS OF WILD GARLIC (B).

(Natural size.)

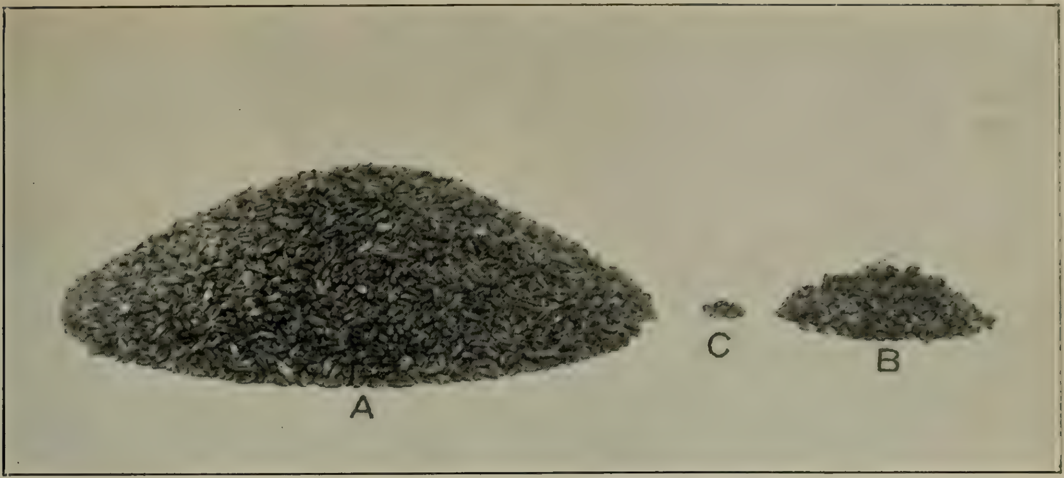


FIG. 1.—WHEAT AND GARLIC FROM LOT A.

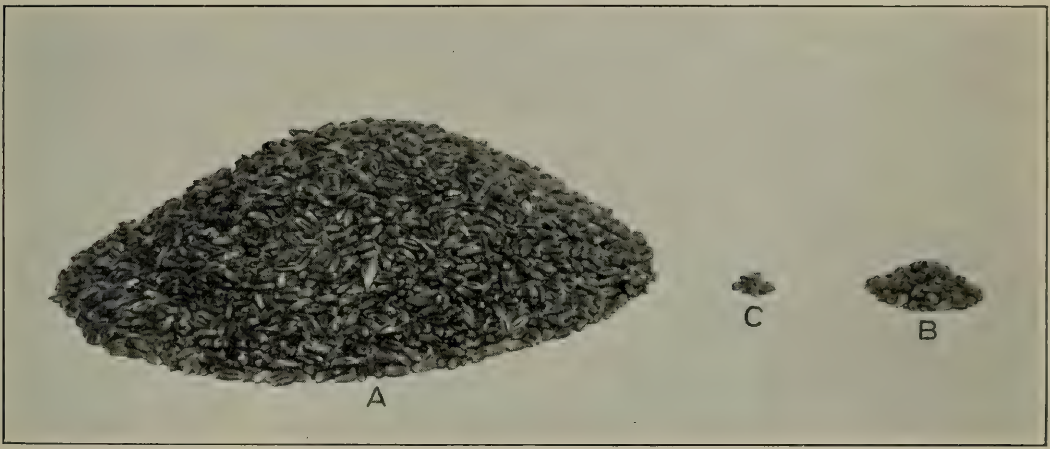


FIG. 2.—WHEAT AND GARLIC FROM LOT B.

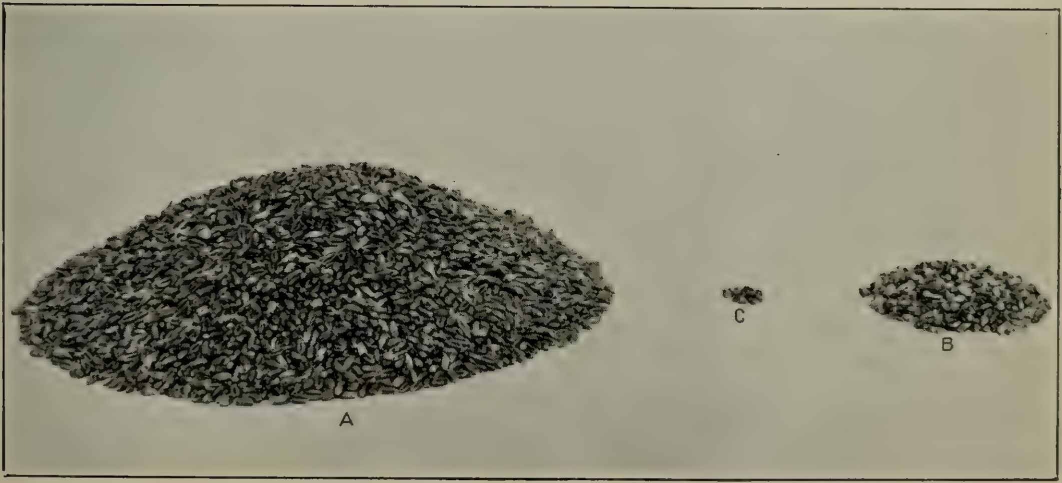


FIG. 3.—WHEAT AND GARLIC FROM LOT C.

ONE-POUND SAMPLES OF GARLICKY WHEAT AS RECEIVED (A, A, A); THE QUANTITY OF GARLIC IN ONE-POUND SAMPLES WHEN RECEIVED (B, B, B); THE AMOUNT OF GARLIC REMAINING IN ONE-POUND SAMPLES AFTER DRYING AND CLEANING (C, C, C).

Doc.
U.S.
Ap

U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART IV.
B. T. GALLOWAY, *Chief of Bureau.*

METHODS OF TESTING THE BURNING QUALITY OF CIGAR TOBACCO.

BY

WIGHTMAN W. GARNER,
Scientific Assistant, Plant Breeding Investigations.

Issued June 9, 1906.

c
239414
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

	Page.
Introduction	5
The smoking test	7
The effects of the filler, the binder, and the wrapper on the burn of the cigar	9
Testing the capacity for holding fire and the evenness of the burn	11
Testing the burn of cigar-filler tobacco	14

ILLUSTRATIONS.

PLATES.

Page.
PLATE I. Variation in burn of wrappers due to different fillers............... 14
II. Variation in burn of fillers due to different wrappers and binders.. 14

TEXT FIGURES.

Fig. 1. Apparatus for testing the burning quality of cigars..................... 8
2. Apparatus for testing the burning quality of wrapper tobacco.......... 12
3. Construction of form on which leaf is wrapped for use in apparatus shown in figure 2.. 12

B. P. I.—212.

METHODS OF TESTING THE BURNING QUALITY OF CIGAR TOBACCO.[a]

INTRODUCTION.

As has been pointed out in previous publications of the Bureau of Plant Industry, a systematic effort is being made to improve the quality and yield of the tobacco crop by employing the latest and most approved methods of selection in the old varieties and by creating and establishing new strains possessing to a marked degree those characteristics most to be desired in the various classes of tobacco which the market demands. This work necessitates the careful testing of a large number of types, as well as many individual selections from each of these types, and for this reason it is very desirable to have at our command methods capable of showing with certainty even slight differences in the essential qualities of the various samples to be examined. It is our purpose to make a careful study of the subject of testing tobacco from a practical standpoint, as well as the relation of the chemical composition of the leaf to its good and bad qualities.

In judging the merits of a cigar tobacco, due regard must be had for the particular use for which it is intended, since the finished cigar consists of three distinct components—the filler, the binder, and the wrapper—each of which must possess certain characteristics. The filler must have, above all else, a fine flavor and aroma and a good "burn." In the case of the wrapper leaf there are a number of requirements to be met, among which are sufficient elasticity, proper color, size, and shape, fineness of veins, freedom from objectionable flavor and taste, a fine "grain," and a good burn. Many of these qualities can be determined by simple inspection, without the use of any specific tests, while others require special laboratory methods. The present article has to do only with the practical methods of testing the burn, deferring to a later day a consideration of the chemical characteristics of the tobaccos which have been tested.

---

[a] In the tobacco breeding experiments conducted by the Plant Breeding Investigations of the Bureau of Plant Industry, particular attention is being given to the improvement of cigar tobaccos, including specially high-grade wrapper and filler types. In connection with these experiments, which are being conducted by Messrs. A. D. Shamel and W. W. Cobey of this Office, it has been found necessary to compare the characters of a large number of selected individual plants to determine which ones are superior in their important characters. The means and methods heretofore used in making such comparative tests were very imperfect, and one important preliminary part of the work is to devise special pieces of apparatus which will enable accurate tests to be made. The devices described by Dr. Garner in the present paper it is believed will greatly facilitate such testing and add to the accuracy of the results. The preliminary notes given by Dr. Garner on the influence of wrapper, binder, and filler on the "burn" of cigars open up an important field of investigation in connection with the testing and breeding of different types of tobacco.—Herbert J. Webber, *Physiologist in Charge of Plant Breeding Investigations.*

There are several elements which go to make a good or bad burn, chief of which are the capacity for holding fire, the evenness of the burn, the color of the ash and its firmness, the coaling or carbonization, and the "puckering" of the leaf immediately in advance of the burning zone of the cigar. The final test of any cigar tobacco must, of course, rest in the smoking of the manufactured cigar, but, while this gives a direct means of determining the character of the ash, it does not furnish accurate information as to the evenness of the burn or the fire-holding capacity of any one of the components of the cigar except with reference to the other two particular components used in the experiment. This is particularly true of the wrapper, as was shown by special experiments carried out to observe the effect of using different fillers and binders with the same wrapper. The result of these experiments will be more fully discussed below. Again, it should be remembered, in this connection, that cigars made by the same workman and from the same lot of tobacco often vary widely in their burn owing to the impossibility of avoiding unevenness in the filler, and this source of error can only be eliminated by several times repeating the experiment. It is evident, therefore, that, in order to get reliable data concerning the relative merits of different wrappers with respect to their burning qualities, the cigar test must be supplemented by some other method capable of giving sharp distinctions as to the fire-holding capacity and evenness of burn.

A method which has long been in use is to ignite the leaf by means of a lighted cigar or a slow-burning match devised by Nessler,[a] and note the number of seconds during which it continues to glow. The mean of several tests is taken as a measure of the capacity for holding fire; but the variation in the results obtained, even upon a single leaf, is so great that little reliance can be placed upon the figures except in a very general way. In this method no account is taken of the area of the leaf burned, and the wide differences obtained on a single leaf are due principally to the fact that frequently the ignited zone soon ceases to glow except for one or more very small streamers, which continue to burn for a much longer period, thereby giving results altogether out of proportion to the true burning qualities of the tobacco in question. Another serious objection to the method is found in the interference of the veins of the leaf; for it seldom happens that the glow can cross these veins except around the outer edges of the leaf, while in the cigar the veins always run longitudinally and so do not interfere with the burn.

---

[a] Landw. Vers. Stat., XI, 399.

The rational procedure would seem to be to test the burn of the leaf when wrapped in some such form as is actually found on the cigar, but without the use of binder or filler. We have devised a method of this kind in which the leaf, after being properly wrapped and dried, is burned with the aid of a slow current of air. The current of air compensates in a measure for the absence of the filler and binder, while its use obviates the unavoidable irregularities of the latter. A detailed description of the apparatus used and the method of carrying out the operation will be found on page 11. This test, combined with the smoking of the cigar, has enabled us to accurately classify a large number of samples of wrapper leaf with respect to their burning qualities.

THE SMOKING TEST.

It is evident that no two persons would smoke a cigar in exactly the same way, nor would the same individual smoke two cigars under exactly similar conditions. It is necessary, therefore, to use some means of smoking the cigars artificially in order to eliminate the personal equation and secure uniformity of conditions. Dr. E. H. Jenkins, in the Annual Report of the Connecticut Agricultural Experiment Station for 1892, has described an apparatus for smoking cigars which was devised by Mr. S. L. Penfield, of Yale University. The "pull" on the cigar is secured by means of an aspirator which is filled by a continuous inflow of water and emptied at regular intervals by a siphon. We have modified this apparatus in a number of details in order to adapt it to our needs, and we give herewith a description of the form and dimensions which we have finally adopted for use in our investigations. In this apparatus as many as four cigars may be smoked simultaneously, while held in such a position that they may be readily compared throughout the operation.

By reference to the accompanying illustration (fig. 1) it will be seen that the holders (*a*, *b*, *c*, and *d*) for the cigars are so arranged that they all lie in the same vertical plane, each one 2 inches above and having its horizontal arm 2 inches shorter than the next lower. A screen with a white covering is placed immediately in the rear of the holders to serve as a background, thereby facilitating observation of the character of the ash. Between the flask bearing the holders and the aspirator and connected with these by means of glass tubing is a check valve consisting of a T-tube (*e*), the lower arm of which dips beneath the surface of the water in a suitable vessel (*f*), thus preventing a backward draft through the cigars while the aspirator is filling. The smoke which escapes through this valve has a very disagreeable odor; hence, it is well to use a bottle fitted with a stopper with two holes, through one of which passes the lower arm of the T-tube (*g*), while through the other passes one end of a long tube (*h*), which carries away the obnoxious fumes. The aspirator consists of a glass cylinder (*i*), the upper end of which is fitted with a rubber stopper containing two holes through which pass tubes leading to the water supply (*k*) and to the flask carrying the cigar holders (*l*), respectively. The lower end of the cylinder is closed with a rubber stopper bearing the small arm of the siphon (*o*). The tube furnishing the water supply is connected with a reservoir provided with a constant-level attachment. To the lower end of the small arm of the siphon is attached a glass tube (*m*) bearing a small bulb which materially assists in breaking the flow of the water at the moment the aspirator is emptied. The tubing connecting the parts of the apparatus should not be less than

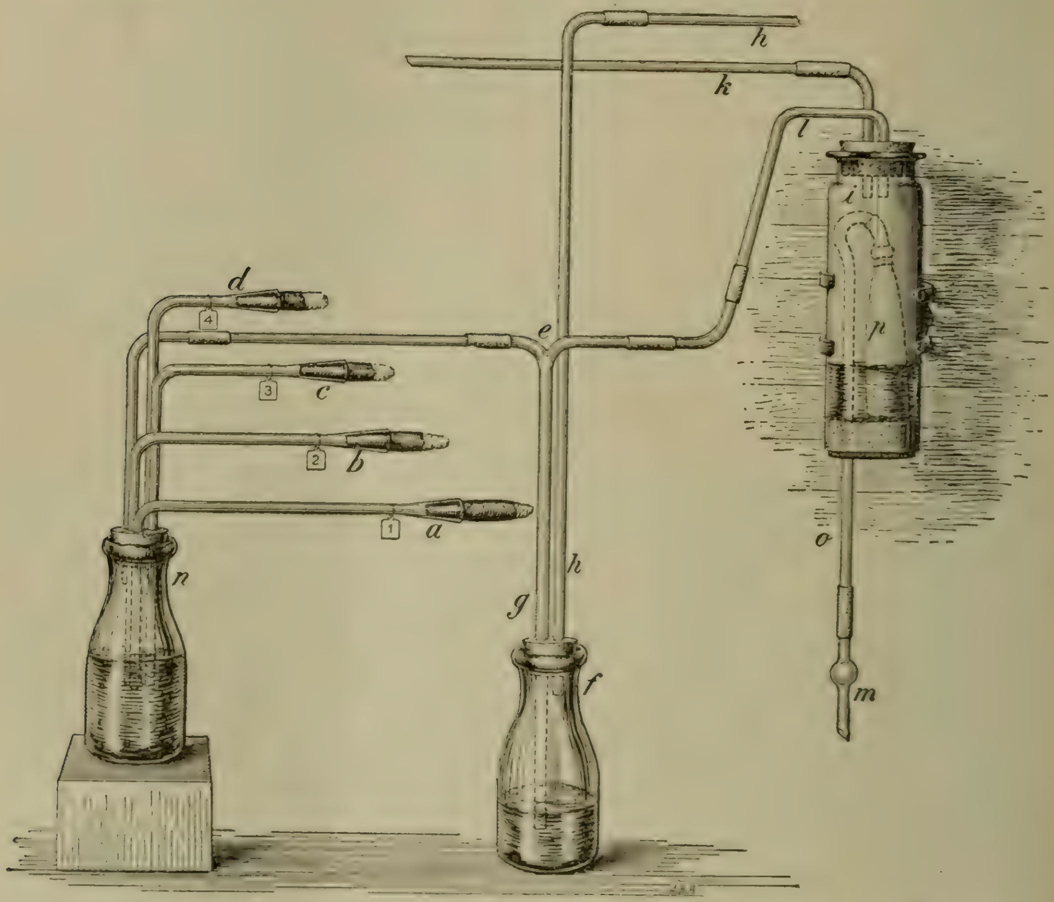


FIG. 1.—Apparatus for testing the burning quality of cigars: *a*, *b*, *c*, *d*, holders for cigars; *e*, T-tube, the lower arm of which, *g*, dips beneath surface of water in *f*; *h*, *h*, tube for leading away tobacco smoke; *i*, aspirator; *k*, tube leading to water supply; *o*, *p*, long and short arms of siphon; *l*, tube connecting cigar holders with aspirator; *m*, tube, with bulb, attached to long arm of siphon; *n*, flask carrying the cigar holders.

6 to 8 mm. internal diameter; otherwise the tubes will frequently become clogged by the condensation products of the smoke. The container for the cigar holders (*n*) is filled about two-thirds full with dilute sulphuric acid, which serves as an acid wash for the smoke, retaining the organic bases and thereby further helping to prevent the choking up of the machine. The lower ends of all the cigar holders should, of course, extend to exactly the same depth below the surface of the acid.

In the machine which we now have in operation, the relation between the short arm of the siphon and the internal diameter of the aspirator is such that the volume of water delivered at each emptying of the latter is 600 c.c. This corresponds to an actual capacity of about 450 c.c. for the aspirator, the difference, of course, representing the volume of water entering the aspirator from the supply pipe while the siphon is in action. The rate of inflow from the supply tank is approximately 900 c. c. per minute. The internal diameter of the long arm of the siphon is 8 mm., while that of the short arm is 25 mm. The entire length of the long arm of the siphon exceeds that of the short arm by 40 cm. An apparatus of the above-mentioned dimensions will smoke four cigars of the Perfecto type, 4¾ inches in length, in about thirty minutes, a rate which is probably somewhat above that of the average smoker. The pull on the cigar occurs at intervals of thirty seconds and continues for a period of ten seconds. The frequency of the pull is controlled by the rate of inflow of the water from the supply tank, while its duration is governed principally by the relation between the diameter of the small arm of the siphon and the volume of the aspirator.

THE EFFECTS OF THE FILLER, THE BINDER, AND THE WRAPPER ON THE BURN OF THE CIGAR.

As preliminary to the use of the cigar test in examining wrapper leaf, a series of experiments was carried out to determine the relative effects of the three components of the cigar on the burn. For this purpose a number of cigars were made by an expert workman, using four different types of wrapper on each of four different types of filler. In a portion of the cigars the binder used was taken from the same leaf as the wrapper, while in the remainder a sample of Connecticut Broadleaf tobacco was employed for this purpose. These cigars were smoked in the above-described apparatus under conditions as nearly uniform as could be obtained, and the evenness of the burn and the character of the ash were carefully noted.

With reference to the evenness of the burn, markedly different results were obtained when wrappers taken from the same sample were smoked on different types of filler. A typical case of this kind is shown in Plate I. The twelve cigars shown were all made from the same sample of wrapper, and in each case the binder was taken from the same leaf as the wrapper. In the first group (A), a sample of filler grown in Texas from Cuban seed was used; in the second group (B), a heavy filler grown in Ohio from domestic seed; in the third group (C), a filler grown in South Carolina from Cuban seed; in the fourth group (D), an imported Cuban filler. The wrapper used on these cigars was a type of Sumatra tobacco grown in Connecticut and had a very good burn. The Texas and imported Cuban fillers were known to have an excellent burn, while the South Carolina filler was markedly inferior in this respect and the Ohio filler intermediate in burning qualities. It will be seen that this sample of wrapper burned quite evenly when used with the imported Cuban and Texas fillers, while with the Ohio and especially the South Carolina fillers the burn was decidedly uneven.

On the other hand, the effect of using different types of wrapper on the evenness of burn of any one type of filler was less marked (see Pl. II, A, B, and C; also Pl. I, D). The filler used in this experiment was the imported Cuban, while the wrappers were taken from four different types of Sumatra tobacco grown in Connecticut. Of these four types of wrappers, that shown in Plate I, group D, had the best burn and the one shown in Plate II, group C, the poorest, although little difference could be seen between the two when smoked on the Cuban filler. The use of different binders did not cause any marked differences in the evenness of the burn, as is shown in Plate II, groups C and D. The cigars used in this experiment were all made from the same wrapper and the same filler, while in group D a sample of Connecticut Broadleaf tobacco was used as the binder, and in group C the binder was taken from the same leaf as the wrapper.

Another important factor in determining the evenness of the burn is the proper balancing of the component parts of the cigar. It was found, for example, that a very light[a] wrapper will not give good results on a heavy filler, even though both of these may in themselves possess a good burn. It will readily be seen that a very thin wrapper which burns readily and very rapidly will, when placed on a heavy, slow-burning filler, tend to burn in advance of the latter, and the effect will generally be an uneven burn. The same result is obtained when any cigar is smoked very rapidly, for the reason that the oxygen of the air has freer access to the outer edges of the burning zone and under the added stimulus it rarely happens that a cigar will burn evenly.

As regards the character of the ash, the wrapper and the binder are relatively of much more significance. It was found, it is true, that some fillers give an ash lacking in compactness and liable to split asunder, but the tendency to flake seems to be controlled almost entirely by the character of the wrapper and binder. Furthermore, this lack of cohesion in the ash of a wrapper may be largely overcome by the use of a good binder. As to the color of the ash, a binder having a good burn will impart to the ash of the wrapper a lighter tint and a more uniform color. The general results of these experiments may be summarized as follows:

---

[a] The terms *light* and *heavy* as used in this connection refer to the body or thickness of the leaf, which largely controls the rapidity of the burn.

(1) In order to secure a good burn, due consideration should be given to the proper balancing of the components of the cigar; that is, a heavy filler should be wrapped with a comparatively heavy wrapper, while a light-bodied filler requires a light-bodied wrapper.

(2) Of the three components of the cigar, the filler exerts the strongest influence on the evenness of the burn.

(3) The influence of the wrapper and binder is shown most strongly on the character of the ash, and the binder very materially influences the ash of the wrapper in this respect.

TESTING THE CAPACITY FOR HOLDING FIRE AND THE EVENNESS OF THE BURN.

The factors of holding fire and of burning evenly are of prime importance in judging the burn of tobacco, and any sample found markedly deficient in these points may be rejected without applying any further test. As has been previously stated, the old method of measuring the fire-holding capacity is likely to lead to erroneous conclusions, while there has heretofore been no direct method of determining the evenness of the burn of wrapper leaf. In the process which we have used for testing wrapper tobacco with regard to these elements of the burn, the area of the leaf consumed, rather than the time elapsing before the glow is extinguished, is measured.

The form of the apparatus used in this method will be understood by reference to the accompanying illustration (fig. 2). The essential feature is the form on which the leaf is wrapped, consisting of a collapsible wooden tube, one end of which fits into a glass tube of the same diameter. This latter is in turn connected with a second glass tube through which is drawn a current of air. The best material for making the wooden form is well-seasoned cherry with a straight grain, but ash has also been found to answer the purpose very well. From the wood selected is made a cylinder 5 inches in length, ¾ inch in diameter at one end, and tapering slightly to the other end (see fig. 3). In the larger end of the cylinder a ⅜-inch hole is bored to a depth of 3¾ inches, and the shell thus formed is separated into six equal segments by sawing to a depth of 3½ inches. The smaller end is cut down for a distance of 1½ inches, so as to fit snugly into the glass tube. The shoulder thus formed should correspond in depth to the thickness of the wall of the glass tube. Near the larger end of the form a groove (*c*) is cut, into which is fitted a rubber band. The plug (*d*) has a diameter such that when inserted in the end of the form the latter is expanded to its original size. The receiver (*a*) for the form is made by drawing out one end of a short piece of thick-walled glass tubing. All of the above dimensions are based on tubing having an internal diameter of 14 mm. (9/16 inch) and an external diameter of 18 mm. (11/16 inch). The small end of the receiver is fitted with a soft cork (*b*), by means of which it is connected with the other portion of the apparatus.

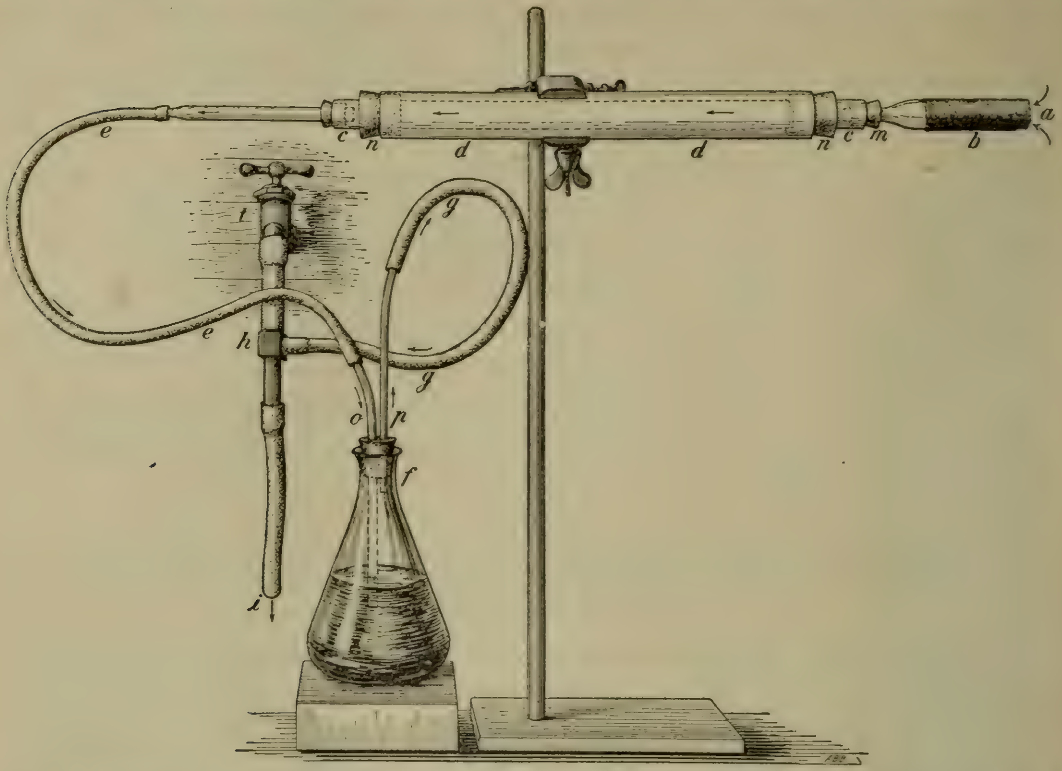


FIG. 2.—Apparatus for testing the burning quality of wrapper tobacco: *a*, entrance of air current; *b*, wrapper to be tested; *c*, *c*, glass tube to which the form bearing the wrapper is attached by means of the cork, *m*; *d*, *d*, large glass tube fitted with corks, *n*, *n*, through which passes *c*, *c*; *f*, flask containing water; *o*, small glass tube dipping beneath the surface of the water in *f*; *p*, short glass tube leading from *f*; *h*, pump by means of which the current of air is secured; *e*, *e* and *g*, *g*, rubber tubing connecting parts of apparatus; *t*, water tap; *i*, outflow of water.

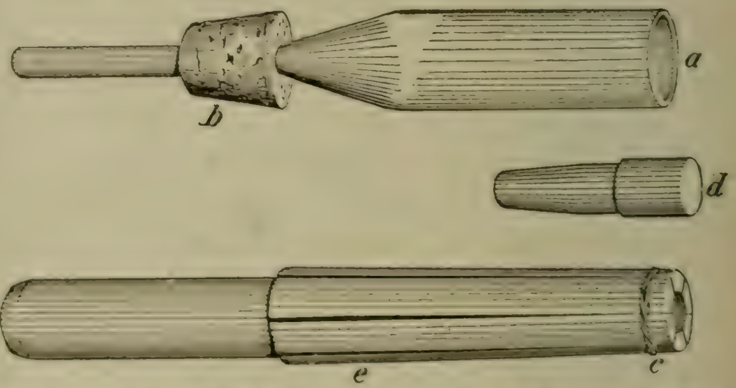


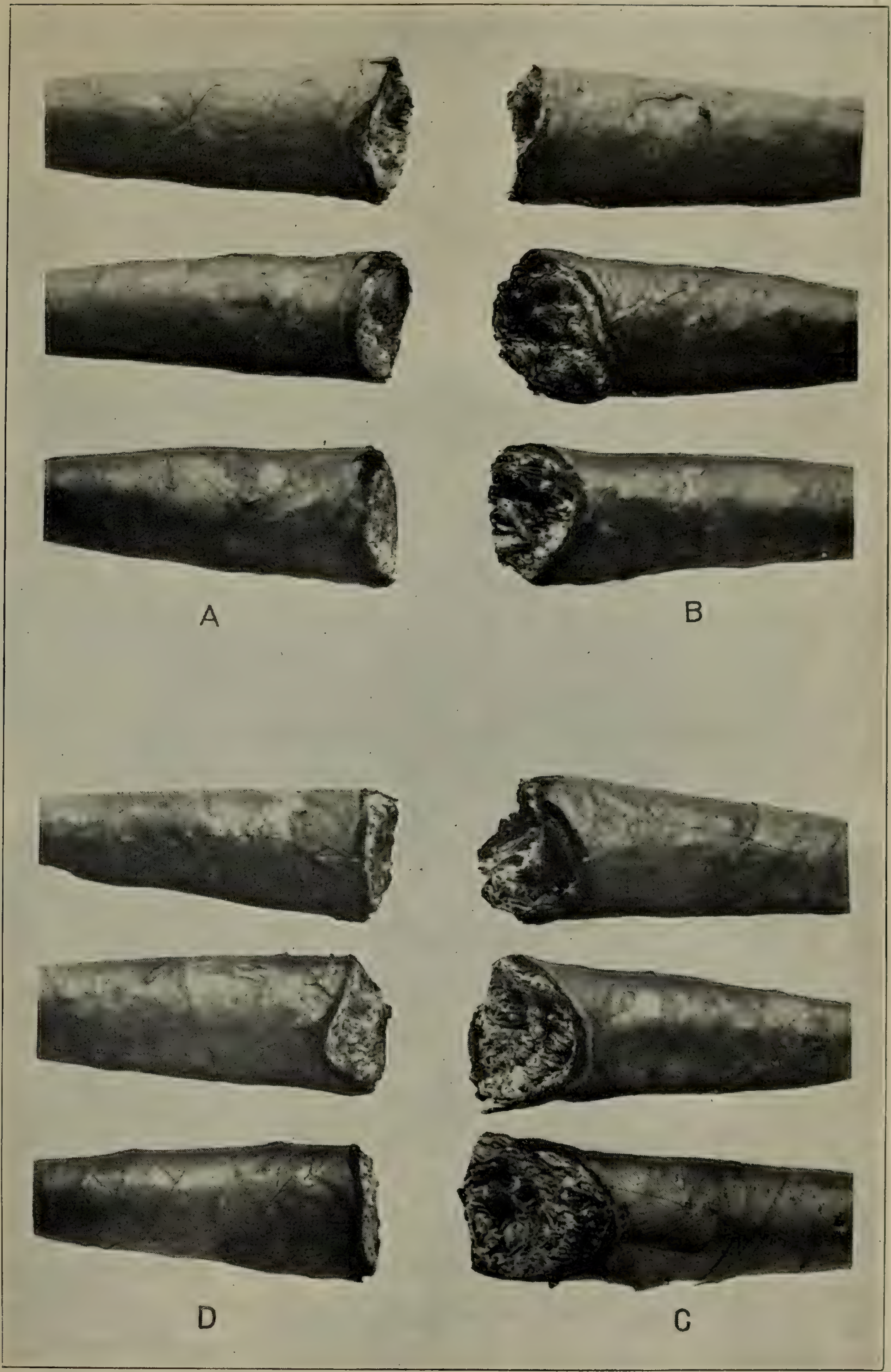
FIG. 3.—Construction of form on which leaf is wrapped for use in apparatus shown in figure 2: *a*, glass tube for receiving the form; *b*, cork by which receiver (*a*) is connected with remainder of apparatus shown in figure 2; *c*, rubber band for collapsing the form; *d*, plug for expanding the form; *e*, form on which leaf is wrapped.

From the leaf to be tested, which should be quite damp, the wrapper is cut into a form quite similar to that used for cigars, and the same rules are observed as regards the cutting of right-handed and left-handed wrappers, etc. Beginning at the outer end the wrapper is rolled quite tightly, first on the form and then on the glass. At the beginning of the process of rolling, the extreme outer corner of the base of the wrapper is attached to the overlapping portion with a bit of cigar paste, and at the end of the operation the tip of the wrapper is attached to the receiver by the same means. A number of samples to be tested are thus wrapped on the forms and set aside until they have dried out properly. The plug in the end of the form is then withdrawn and the rubber band causes the walls of the latter to collapse, so that it can be easily withdrawn from the receiver. This leaves the sample of wrapper securely attached to the glass tube, and in exactly the same form it would have on a cigar. The tube carrying the sample to be tested is connected with the remainder of the apparatus, shown in figure 2, the construction of which will be understood without further explanation. The current of air is furnished by means of an ordinary filter pump, and its rate can be controlled with sufficient accuracy by measuring the flow of water through the pump. The end of the wrapper is ignited with a flat gas flame, and the evenness of the burn and the portion consumed before it ceases to glow are carefully noted. Our method of recording the results is to grade each sample on a scale of ten, both with reference to the evenness of the burn and the fire-holding capacity. Of course, standards in these tests are purely arbitrary, as the results are only intended to be comparative. Under the conditions laid down for the experiment, wrappers having markedly good burning qualities will burn up completely and evenly with only one lighting, and these are given a grade of 10.

For the purpose of comparing the results obtained by this method with those given by the cigar test with reference to the evenness of the burn, a number of leaves were selected from different types of wrapper tobacco. One half of each leaf was used for wrapping a cigar and the second half was wrapped on the form for testing, as has just been described. There was a decided lack of agreement in the results obtained by the two methods when only one type of filler was used in making the cigars. It was found that frequently a wrapper that graded only 5 or 6 on a scale of 10 in what may be called the "form test" would burn quite evenly on the cigar, whereas another wrapper grading as high as 9 in this test would show an uneven burn on the cigar. A good illustration of this point is found in a wrapper which was scored 10, 9, 10, respectively, in three experiments with the form test and gave a fire-holding capacity of 65 seconds by the old method of Nessler. On one type of filler this wrapper gave a very uneven burn, but when smoked on a lighter filler the burn was perfectly satisfactory. These results, then, seem to emphasize the fact that, although the final judgment as to the burning qualities of a wrapper which has shown up well in the preliminary tests must be based on the smoking of the cigar, great care must be exercised to avoid the sources of error in this test which have been previously discussed. The test should not only be repeated with a single type of filler to avoid the effects of any possible unevenness or other imperfections in the manufacture of the cigars, but at least two different types of filler should be used, one of these being heavy and the other light in the sense in which these terms are used here.

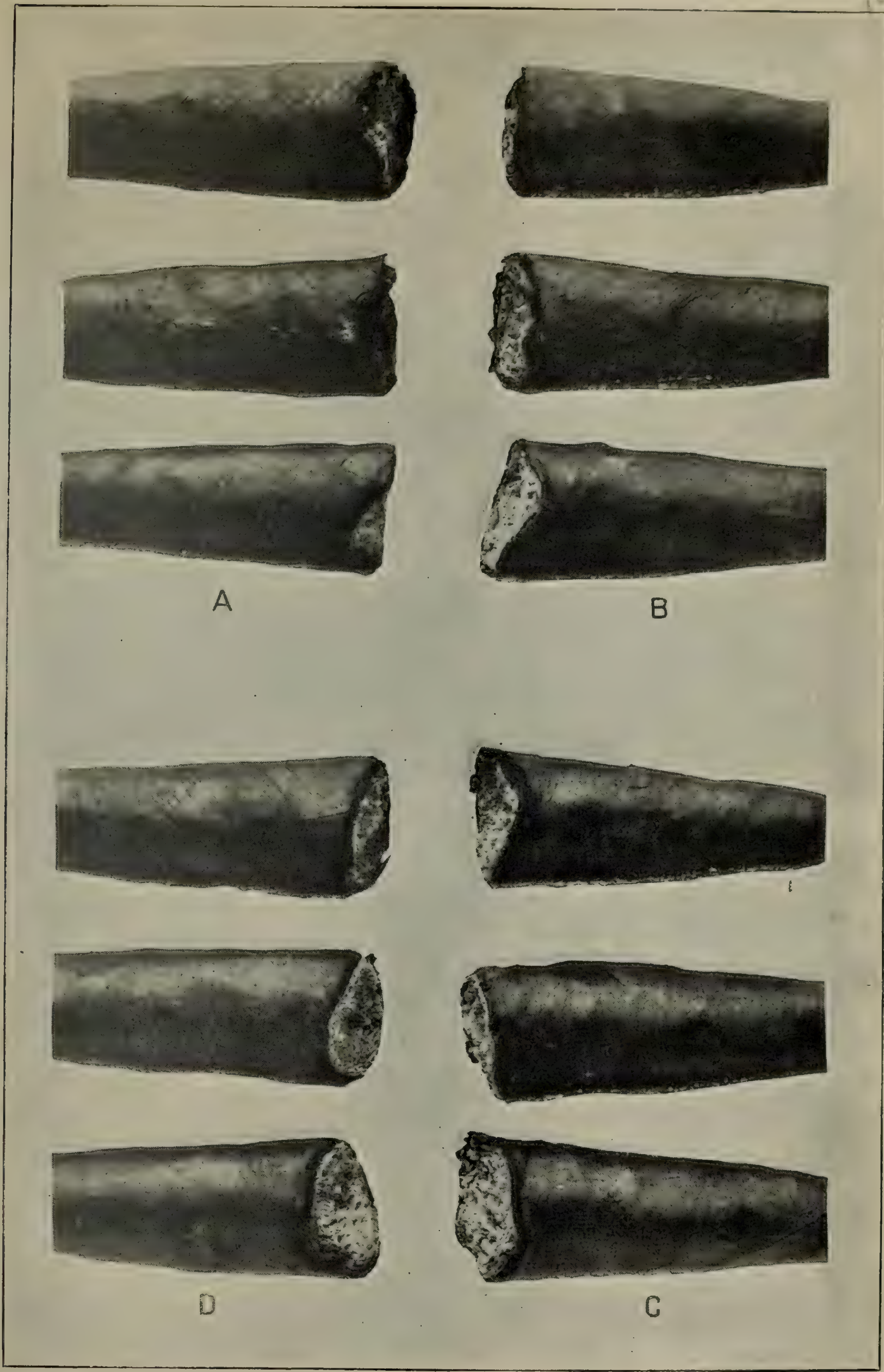
TESTING THE BURN OF CIGAR-FILLER TOBACCO.

Testing the burn of a filler is a much simpler problem than is the case with a wrapper. The principal elements of the burn are the evenness and the capacity for holding fire, and the character of the ash is unimportant, except that it should be compact. The evenness of the burn and the fire-holding capacity are best determined by using the cigar test. In the case of filler tobacco the capacity for holding fire thus refers simply to the length of time the cigar will continue to burn after being lighted without being puffed by the smoker. The effects of the binder and wrapper on the burn may be avoided by making the entire cigar from the filler leaf to be tested. Another decided advantage in making the whole cigar from the same tobacco is that the aroma, which is so important in the filler, can also be tested at the same time. In determining the fire-holding capacity it is only necessary to light the cigar and test it at gradually increasing intervals of time to find whether it has ceased to burn. It is, however, desirable to test the fire-holding capacity and the evenness of the burn on separate cigars if sufficient material is at hand for this purpose.



VARIATION IN BURN OF WRAPPERS DUE TO DIFFERENT FILLERS: A, FILLER GROWN IN TEXAS FROM CUBAN SEED; B, FILLER GROWN IN OHIO FROM DOMESTIC SEED; C, FILLER GROWN IN SOUTH CAROLINA FROM CUBAN SEED; D, AN IMPORTED CUBAN FILLER.

The same sample of Sumatra wrapper was used throughout and the binder was taken from the same leaf as the wrapper in each case.



VARIATION IN BURN OF FILLERS DUE TO DIFFERENT WRAPPERS AND BINDERS: A, B, C, THREE DIFFERENT TYPES OF CONNECTICUT-GROWN SUMATRA WRAPPER ON SAME SAMPLE OF CUBAN FILLER, BINDER BEING SAME AS WRAPPER IN EACH CASE; D, SAME WRAPPER AND FILLER AS C, BUT CONNECTICUT BROADLEAF USED AS BINDER.

Gov. Doc.
U.S.
Ap

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART V.

B. T. GALLOWAY, *Chief of Bureau.*

THE DRUG KNOWN AS PINKROOT.

BY

W. W. STOCKBERGER,
EXPERT, DRUG-PLANT INVESTIGATIONS.

ISSUED OCTOBER 9, 1906.

23941 d
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

Page.
Introduction 5
Trade varieties of pinkroot 5
Identity of chief substitutes 6
Minor adulterants 7
Methods of distinguishing pinkroot from its substitutes 7

ILLUSTRATIONS.

PLATES.

Page.
Plate I. Pinkroot (*Spigelia marilandica* L.) 6
II. East Tennessee pinkroot (*Ruellia ciliosa* Pursh) 6

TEXT FIGURES.

Fig. 1. Cross section of the root of *Spigelia marilandica* L 8
2. Cross section of the root of *Ruellia ciliosa* Pursh 8

B. P. I.—229.

THE DRUG KNOWN AS PINKROOT.

INTRODUCTION.

The drug known as pinkroot is derived from the underground portions of *Spigelia marilandica* L. (Pl. I), an American herb now found growing most abundantly in the Southern States and occurring locally in the Mississippi Valley and eastward. It came into use in America as a vermifuge about 1723 and because of its valuable properties soon came to occupy an important place in materia medica. Unfortunately, however, conflicting reports on its physiological effects in time established for pinkroot a reputation for uncertain action, and within the last fifty years the use of this drug, once regarded as highly reliable and valuable, has greatly decreased. Since it has seldom been held at high prices the cost has not operated to drive it out of the markets.

The cause of the apparent loss of high efficiency formerly claimed for pinkroot has engaged the attention of students of crude drugs for many years. The demonstration by Dr. R. H. True[a] that an unsuspected substitute had crept into the markets and to a considerable degree replaced the true article has explained in large measure the unfavorable commercial and medical status of pinkroot. The results here outlined of a detailed study of pinkroot and its more important adulterants may serve to aid collectors in discerning the real pinkroot and to assist drug experts in distinguishing the plant from its sophistications in its commercial form.

TRADE VARIETIES OF PINKROOT.

The complex nature of the material put upon the market as pinkroot has long been known to the drug trade, and although the real nature of the spurious article was not understood, its presence was recognized, and various sorts of pinkroot came to be distinguished by definite trade names—e. g., true pinkroot, genuine pinkroot, southern pinkroot, Georgia pinkroot, East Tennessee pinkroot, western pinkroot, and true fiber pinkroot. The visible differences by which these trade varieties are segregated may be utilized in distinguishing the true from the false pinkroot, as it is now definitely known that certain of the trade varieties are wholly composed of worthless substitutes.

---

[a] Pharmaceutical Review, 21: 364, 1903.

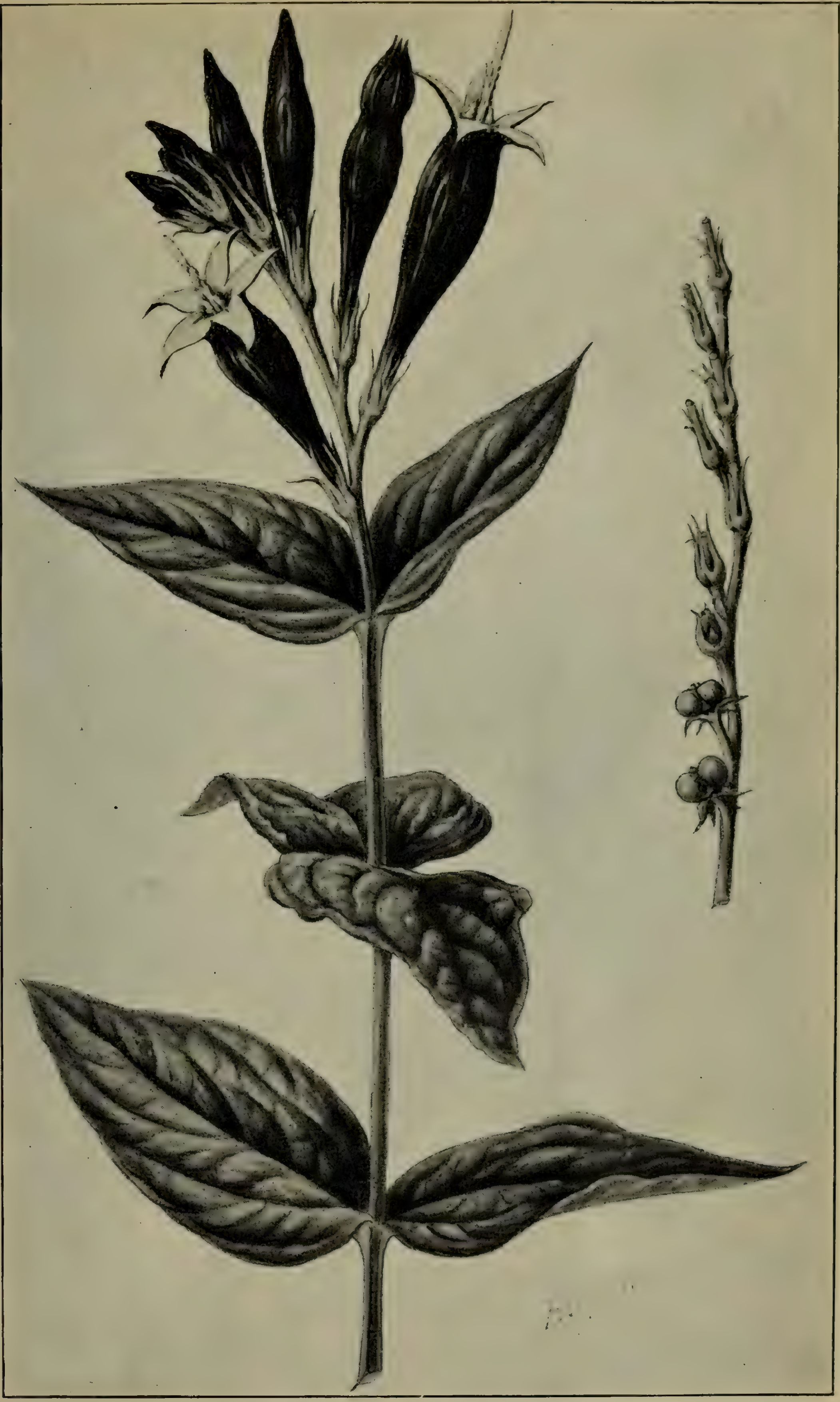
In many cases careless or unscrupulous collectors and dealers have not regarded the distinguishing features of the various sorts of pinkroot, or have been ignorant of them, with the result that very general confusion exists as to the character of the real drug and its adulterants. The authors of some prominent publications on crude drugs have evidently based their observations on trade varieties of pinkroot, as they have illustrated and described one of the most important adulterants as true pinkroot.

IDENTITY OF CHIEF SUBSTITUTES.

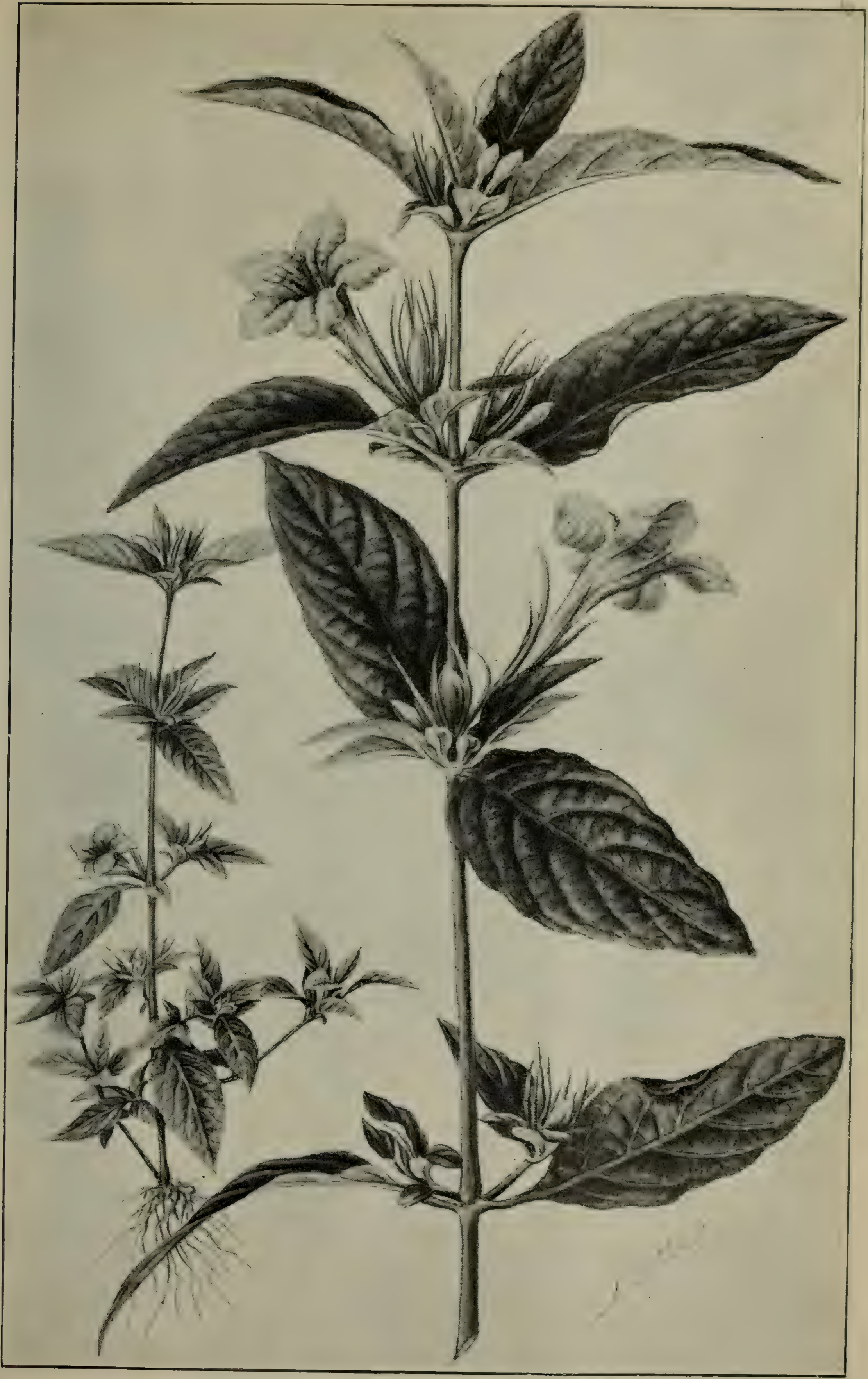
East Tennessee pinkroot (*Ruellia ciliosa* Pursh), a member of the plant family Acanthaceae, is the most important adulterant. Observations on the plant structures present in commercial samples of pinkroot convinced Dr. R. H. True, in 1900, that the chief part of this crude drug consisted of a substitute instead of Spigelia and that this substitute was a species of Ruellia. In trying to get plants of pinkroot for cultivation, Doctor True, in 1903, purchased several hundred roots from a dealer in eastern Tennessee. These roots were set out in the testing gardens of the Bureau of Plant Industry at Washington, D. C., and the plants kept under close observation. On developing they were found to differ markedly from Spigelia, and upon flowering were identified as *Ruellia ciliosa* (Pl. II), a plant which had never appeared in the list of suspected adulterants prior to this time.

The examination of the microscopic structure of this plant recalled at once the figures in some text-books purporting to represent Spigelia and those illustrating an article by Greenish in the Pharmaceutical Journal, 1891, on the structure of *Phlox carolina*, a plant which had long been regarded as an extensive substitute for pinkroot. It was evident that a double confusion existed with regard to Ruellia. On the one hand it was so widely mistaken for Spigelia that its peculiar structures have been regarded as diagnostic of pinkroot, and on the other it was recognized as a substitute, but wrongly regarded as Phlox, a plant lacking many of the striking characteristics of Ruellia.

In order to satisfactorily determine the relation of these substitutions to the true pinkroot, observations have for three years been made upon plants of Spigelia, Ruellia, and Phlox under cultivation at Washington, D. C., and fresh material secured from them has been used in making a comparative study of their structure. The results of this study do not support the view that Phlox is an adulterant of pinkroot, and, moreover, several samples of a substitution supposed to be Phlox have proved, upon examination, to be composed entirely of Ruellia. It is only through long and familiar observation in the



PINKROOT (SPIGELIA MARILANDICA L.).



EAST TENNESSEE PINKROOT (RUELLIA CILIOSA PURSH).

living condition of all species here concerned that it has been practicable to uncover fully the true relations involved in the drug called pinkroot.

MINOR ADULTERANTS.

Aside from Ruellia the adulterants of Spigelia may be regarded as impurities, due in the main either to the carelessness of the collector in not sorting out the roots with which the plant was associated in its growth, or perhaps to a lack of familiarity with the plant on the part of young or inexperienced collectors. With Spigelia other roots sometimes occur which have a greater market value than the true pinkroot, and therefore can not be regarded as intentional adulterants. The worthless roots frequently present, however, may have been introduced by the collector with full knowledge that a fraud was being perpetrated. In commercial samples of pinkroot, among other impurities have been observed roots of golden seal (*Hydrastis canadensis* L.), serpentaria (*Aristolochia serpentaria* L.), soapwort (*Saponaria officinalis* L.), wild yam (*Dioscorea villosa* L.), and stoneroot (*Collinsonia canadensis* L.).

METHODS OF DISTINGUISHING PINKROOT FROM ITS SUBSTITUTES.

Once familiar with the true pinkroot it is hard to see how any drug collector could confuse it with the plants so frequently substituted in its place. Spigelia and Ruellia grow over large areas, largely overlapping and in much the same habitat, and have on the whole a certain general resemblance; but they should be readily distinguished by observing any one of their several striking characteristics.

In Ruellia (Pl. II) the flowers are borne scatteringly along the stem in the axils of the leaves; in Spigelia (Pl. I) they are aggregated at the top of the plant in a one-sided spike. In Ruellia the pale magenta-colored corolla forms a slender tube below, expanded upward into a broad, flaring limb. The anthers and style are not protruded. In Spigelia the corolla forms a rather broad tube, narrowest at the throat, prolonged upward into spreading, narrow, triangular portions. The exterior is brilliant cardinal in color, bright yellow on the inside; the style and anthers are exserted. The leaves of Ruellia are bright green, usually short-petioled or sessile, frequently more or less hairy. In Spigelia they are dark green, glossy, and sessile.

In the crude drug the forms are separated by less evident gross characters. Ruellia, however, has a coarser, harsher root system than Spigelia, and the roots show a tendency to lose the cortical tissues, leaving the naked, woody cylinder exposed. The roots of Spigelia are delicate, fibrous, and usually very numerous. When dry they break and crumble very readily.

The difference in structure between Spigelia and its substitutions as seen under the microscope are usually very marked. This is especially true of Ruellia, the only important adulterant found with Spigelia, since the other plant parts sometimes present are usually recognized by their gross characters. A comparison of figures 1 and 2 will show the most important differences in minute structure. The numerous cystoliths present in Ruellia as a very conspicuous feature are wholly lacking in Spigelia and *Phlox ovata*. The large sclereids of the root of Ruellia are not found in the other two plants, and starch, which is present in Spigelia, is absent in both Ruellia and Phlox.

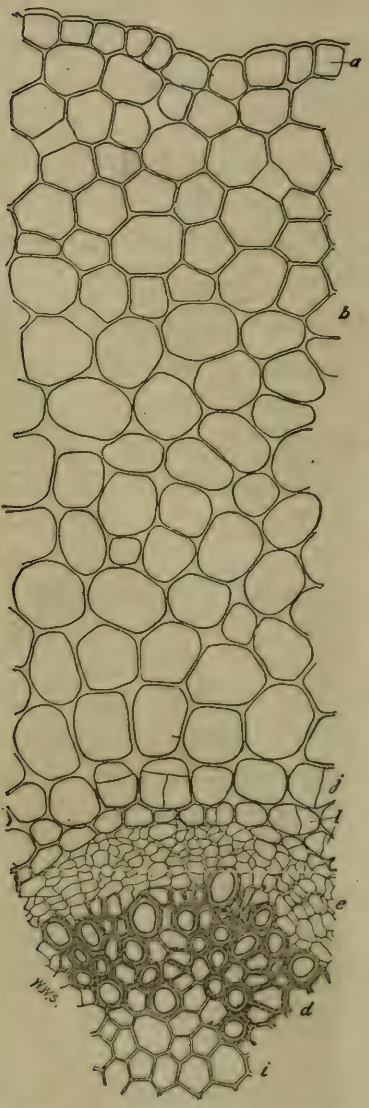


FIG. 1. Cross section of root of *Spigelia marilandica* L.: *a*, epidermis; *b*, cortex; *d*, xylem; *c*, cambium; *i*, pith; *j*, endodermis; *l*, pericycle. × 180.

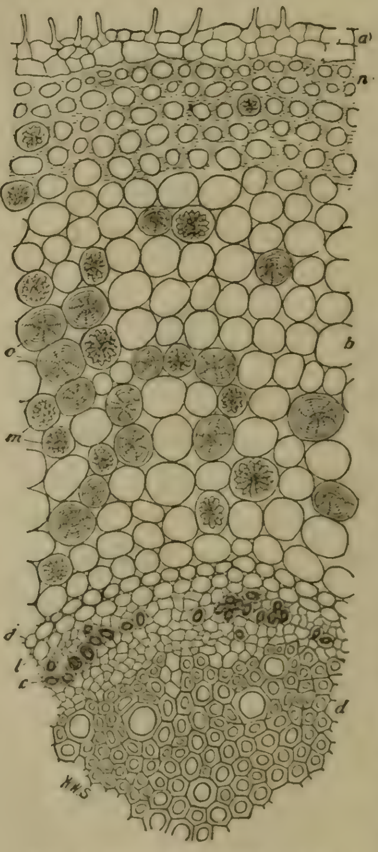


FIG. 2. Cross section of the root of *Ruellia ciliosa* Pursh.: *a*, epidermis; *b*, cortex; *c*, bast fibers; *d*, xylem; *j*, endodermis; *l*, pericycle; *m*, cystoliths; *n*, collenchyma; *o*, sclereids. × 150.

In the powdered form Ruellia always reveals its presence by the numerous stone cells and cystoliths, which usually remain intact even in finely powdered material. Powdered samples of the underground portions of the Phlox at hand gave no reaction for starch. The fineness of the starch grain of Spigelia and its lack of striking characters render uncertain its identification among many other plant starches which might be readily introduced in the powdered drug. The starch grains of Spigelia measure about 4 μ, and in powdered pinkroot are associated with parenchyma cells and long light-colored sclerenchyma fibers. The absence of starch from a powder supposedly made of pinkroot suggests at once that the material is not Spigelia. On the other hand, the presence of starch, while indicative of Spigelia, is by no means conclusive proof of its presence.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART VI.

B. T. GALLOWAY, *Chief of Bureau.*

ORCHARD GRASS.

BY

R. A. OAKLEY,
Assistant Agriculturist, Farm Management
Investigations.

Issued October 8, 1906.

239414
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

Page.

Introduction 5

Methods of culture 6

  Seeding 6

  Mixtures with red clover 7

  Mixtures with other grasses 8

  Life of meadows 9

Uses and value 9

  Hay 9

  Pasture 10

  Seed 10

    Harvesting the seed crop 11

    Thrashing 11

    Handling the aftergrowth 12

    Value of the straw 12

    Weeds in orchard grass seed fields 13

    Other grasses in fields intended for seed 14

Summary 15

ILLUSTRATIONS.

Page.

Plate I. Fig. 1.—Harvesting orchard grass for seed. Fig. 2.—Method of shocking orchard grass; shocks showing bands at top........ 10

B. P. I.—230.

ORCHARD GRASS.[a]

INTRODUCTION.

Orchard grass (*Dactylis glomerata* L.) is a well-known standard grass which is grown to some extent in every State in the Union and quite commonly in the region east of the Mississippi River and north of the northern portions of Alabama and Georgia. It attains most importance, however, in Kentucky, southern Indiana, Tennessee, North Carolina, Virginia, West Virginia, and Maryland, and seems quite thoroughly adapted to a variety of soils in these States.

It may be said that the general opinion of farmers in regard to the value of orchard grass either for hay or pasture is quite unfavorable. This unfavorable opinion, which is due somewhat to prejudice, exists to a greater extent in the timothy region than elsewhere, and as the limits of this region are reached and crossed orchard grass is much more highly regarded. The objectionable features of the grass are in general its bunchy habit, coarseness, and the unpalatability of its hay unless cut at the proper state of maturity. These objectionable features are not alone the cause of its unpopularity or the reason why it is not grown more generally. There is no doubt that orchard grass could be grown very successfully throughout the greater portion of the timothy region, but as the demand for any hay except timothy is very limited farmers see little inducement for them to raise it. On account of its maturing well with a number of other very valuable grasses and clovers its popularity may in time increase as the advantages of such mixtures become more generally appreciated.

---

[a] In connection with the general plan of the Farm Management work it is contemplated to take up the study of various seed crops. Much interest is now being manifested in better seeds for the farmer. This is especially true of forage-crop seeds, including both grasses and clovers. Mr. Oakley's paper, which is contributed from the Office of Farm Management, conducted under the direction of Prof. W. J. Spillman, is a valuable contribution to the methods followed in growing orchard grass for hay, for pasture, and for seed. Special attention is called to the fact that orchard grass seed as usually grown is for all practical purposes pure. The investigations of this Bureau have shown that considerable quantities of the seed of this grass found in the market contain seed of other and less desirable, cheaper grasses That the seeds of these cheaper forms have been added for the purpose of adulteration seems evident from the fact that the grasses bearing them are not found in orchard grass fields to any extent worth mentioning.—B. T. Galloway, *Chief of the Bureau of Plant Industry.*

Orchard grass is exceedingly variable and offers a large field for selection and breeding. Its variable characters of most importance are its coarseness, bunchiness, and time of maturing. By consistent selection with special reference to the first two characters valuable strains may in time be developed which will not possess the objectionable features of the common orchard grass now being grown.

METHODS OF CULTURE.

SEEDING.

While there are some methods that are generally employed in the culture of orchard grass, still there is a great difference of opinion even among the most successful growers in any one locality as to the best practices. In the seed-producing section of Kentucky and Indiana it is the common custom to sow the grass in February on fall wheat at the rate of from three pecks to one bushel to the acre. Since the crop in this section is almost entirely harvested for seed, it is not considered desirable to sow more than a bushel. In years past as much as two bushels to the acre were sown, but it is now the general opinion that one bushel is sufficient, and even less is often used. A bushel of orchard grass seed weighs 14 pounds. Orchard grass to give large yields of seed should be reasonably thin, as it produces more abundantly when in this condition. It is usually sown broadcast, as it does not feed out well through a press drill, either by hand or with a wheelbarrow or other type of seeder, and is covered very shallow. Good results are often obtained by not covering the seed, and it is quite a common opinion that too deep covering is the cause of many of the failures to secure a stand.

A method of seeding which is often followed in the section mentioned is to scatter the orchard grass straw from which the seed has been thrashed on ground that has been sown to wheat. This is usually done in February. The straw acts as a mulch in this case and the seed needs no covering. It is very essential that it be scattered evenly and very thin; otherwise the stand will be too thick and unsatisfactory. The greatest objection to this practice is that unless the straw is very clean the meadow is sure to be weedy, and some are of the opinion that since the seed that is left in the straw or blown over with it is mostly of poor quality a field of inferior and unequally maturing grass will be the result.

Orchard grass may be sown successfully after corn by splitting the rows with a disk harrow as soon as the crop is removed. This may be done any time during the month of October, and in February or as soon as the weather is favorable the grass may be sown with a broadcast seeder at the ordinary rate, and the ground being uneven at this time the freezing and thawing which follow will cover the seed sufficiently. Disking seems to give much better results than plowing, since the ground if plowed will not have time to thoroughly settle before the time of seeding. Rolling would doubtless be beneficial after seeding in this manner.

In western Virginia and in Tennessee orchard grass is commonly sown the latter part of September or the first of October with wheat on the ground at the rate of a bushel and a half to two bushels to the acre, the wheat being drilled in at the rate of three to five pecks to the acre and the grass sown either broadcast by hand, with a broadcast seeder, or an attachment to the drill, and covered as shallow as possible.

Orchard grass is often sown with oats, usually in March, on ground that has been previously in wheat and which has been plowed the preceding autumn. A half seeding of oats is usually sown in this case, and gives as a result only a fair crop. The grass, however, makes more pasture the first season as a rule than when sown with a full seeding of either wheat or oats. Early fall seeding with winter oats in sections where the latter can be grown may be depended upon to give good results, but on account of the Hessian fly it is not possible to sow it with wheat much before October.

A crop of hay is not expected the first season, whether the grass is sown in the fall or spring, either alone or with a nurse crop. If sown alone a light cutting may be secured, provided the conditions are favorable, in the latter part of August or September; but in general the grass is pastured and not cut except at the time when the grain which is sown with it is harvested. The following season it makes a crop of either hay or seed, as is desired. There may be some advantage in sowing the grass alone for the extra quantity of forage produced the first year, but whether this and any other advantages that may come from seeding in this way will compensate for the profit accruing from the nurse crop is an undecided question.

MIXTURES WITH RED CLOVER.

Throughout almost the entire region where orchard grass is grown it is quite a common practice to sow red clover with it. This practice is a good one, not only for the value of the red clover in maintaining the soil fertility, but also for the fact that its presence greatly improves the orchard grass either for hay or pasture. In the seed-producing sections red clover is a menace to the seed crop, especially the first and second years. As it is impossible to cut the orchard grass above the clover, the leaves and heads get mixed in with the seed and are dificult to separate from it. Although the presence of the leaves in the orchard grass seed materially decreases its commercial value, the advantage of having the clover in the field more than compensates for this.

In sections where the grass is grown for hay and pasture, red clover is sown at the rate of one bushel to 5 or 7 acres, usually as early in the spring as the weather will permit. It is, however, sometimes sown in the autumn at the same time as the orchard grass, but the seed of the two are not mixed, as they do not feed evenly through the drill or seeder. In cases where clover is sown in the spring on orchard grass that has been sown the fall before, it is either covered lightly by means of a drag harrow or left uncovered. Less clover is sown to the acre in seed-producing sections than where the grass is intended for hay or pasture, the customary quantity being one bushel to 8 or 10 acres. In these sections the first crop is frequently cut for hay on account of its containing so much clover. The second crop usually contains very much less and is cut for seed, as are also the following crops, since the clover at the end of two years usually disappears. Pasturing the field appears to materially increase the longevity of the clover, and it is not uncommon to see meadows that are 6 or 7 years old containing almost as much clover as they did the first year.

Much trouble is now being experienced in securing a catch of red clover throughout the greater part of the region where it is grown. As a result alsike is being substituted in some sections, and where it has been tried thoroughly it is giving good results. This difficulty in growing red clover will doubtless soon become a serious proposition, especially in seed-producing sections, and unless alsike or some similar leguminous crop can be grown it will be only a few years until more barnyard manure or commercial fertilizer will have to be used. At the present time there is very little commercial fertilizer applied to orchard grass, although it is the opinion of some of the more successful growers that an application of about 200 pounds of good fertilizer in the spring, just as the grass begins to grow, would yield profitable results.

MIXTURES WITH OTHER GRASSES.

On account of the bunchy tendency of orchard grass it is often desirable to mix it with other grasses for hay or pasture, and while this has not been practiced as yet to any great extent the results obtained from such mixtures are very promising. Aside from affecting the palatability of the grass, the mixtures have a tendency to increase the yield. Orchard grass matures well with tall meadow oat-grass and meadow fescue, and in some localities in Tennessee a mixture of it with the latter is attracting considerable attention, especially for pasture. Doubtless in time orchard grass will be more generally grown for hay and pasture in mixtures with these or other grasses.

LIFE OF MEADOWS.

Orchard grass is a more hardy and permanent grass than timothy, and as a result remains productive in a meadow under most conditions much longer. In the principal sections where it is grown the average life of a meadow is from five to seven years, although it is a question whether it might not be broken up profitably at the end of four years. Throughout almost its entire region Kentucky bluegrass is its natural enemy and works in around the bunches almost to its ultimate exclusion. Redtop and Canada bluegrass also are present in many sections with the Kentucky bluegrass, and at the end of five or six years these three grasses are greatly in the majority. Pasturing seems to facilitate the growth of the bluegrass, inasmuch as it has a tendency to cause the orchard grass to become more bunchy, and it is also a means of spreading the bluegrass seed. During the last year of its existence it is customary to pasture the orchard grass field, and late in the autumn or early in the winter it is broken up and is planted to corn the following spring. It is well to have the field broken up as early as possible so as to give the sod time to rot sufficiently before planting the corn.

USES AND VALUE.

HAY.

According to chemical analysis orchard grass hay should be equal, if not superior, to timothy, but in real practice it does not seem to be able to successfully compete with the latter. In large cities there is practically no demand for any hay except timothy, and the demand for orchard grass hay is only local and very limited. In the timothy region orchard grass is looked upon very unfavorably, but where timothy can not be grown so successfully its hay is used to a greater extent and is considered of very good quality.

As previously stated, orchard grass should be sown thicker when desired for hay than for seed, 2 bushels of good seed to the acre being usually required, for unless thick it becomes coarse and woody. Its value as hay is increased by the addition of red clover or alsike, and where it has been sown with other grasses, such as tall meadow oat-grass or meadow fescue, its quality seems to be improved by such mixtures. The state of maturity at which the grass makes the best hay is when it is just in bloom. Not only does the quality seem to be better at this time, but the yield is also at the maximum.

In some sections it is considered a good hay for horses, but it is of more value for cattle, and especially for fattening them for the market. As a feed for sheep it is of only fair quality. The value of the hay depends not only on the state of maturity at which it is cut, but also on the bunchiness and coarseness of the grass. These characteristics are influenced largely by the method of culture, and it is often for the reason that farmers do not thoroughly understand growing it that they condemn it as a hay grass. Seeding evenly with the proper quantity of seed and careful pasturing are important factors in securing a good meadow.

PASTURE.

For pasture, orchard grass gives best results in mixtures with other grasses and clovers, and is of special importance from the fact that it can be grazed early and late in the season. It is quite a valuable grass if for no other reason than this. It also stands grazing fairly well. It must, however, be closely pastured; otherwise it will become too coarse and woody, and stock will not eat it. Stock do not relish the mature grass, and invariably lose flesh when turned on a field in this condition. To secure best results from pastures, they should be mowed some time during June to keep down the weeds, and again later as needed. In this way they are kept clean and more productive. Bluegrass and white clover are usually very prominent in most orchard grass pastures and are valuable additions, as they grow between the bunches of the orchard grass, thus increasing the yield. The white clover is also of value in maintaining soil fertility.

SEED.

Orchard grass seed is produced to some extent throughout the entire region in which it is grown. There is quite a quantity raised in western Virginia, but the greatest seed-producing area is in the vicinity of Louisville, including Jefferson, Oldham, and Shelby counties, Ky., Clark County, Ind., and some of the counties adjoining those in both States mentioned. Just why there is more seed produced in this section than elsewhere is not definitely known. Some are of the opinion that it is because orchard grass seeds more readily there, which may be true. However, the cultural methods employed by farmers in this section may have something to do with the success attained in raising it. In Oldham County, Ky., the average production is about 55.000 bushels, which represents practically 5,000 acres, as the yield is about 10 to 12 bushels to the acre. The growing of seed in the section referred to is a profitable industry, and there are many farmers who engage in it quite extensively with uniform success. It is said to be a more profitable crop than wheat, and when the harvest of the two conflict orchard grass is given the most attention. The average price of seed for the last ten years has been about $1.25 a bushel. The seed alone does not represent the entire return from the field, for after it is harvested the meadows afford hay or pasture, or both, from which a considerable profit accrues. Orchard grass seed is the controlling crop in this section, and the cropping system is planned to accommodate it.

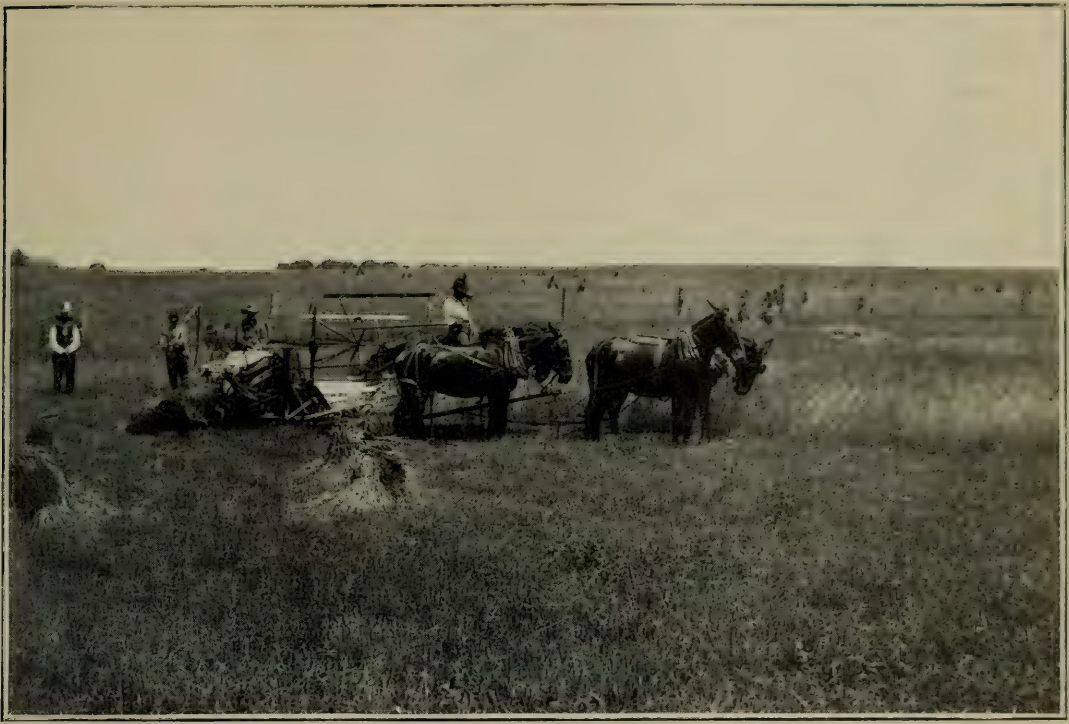


FIG. 1.—HARVESTING ORCHARD GRASS FOR SEED.

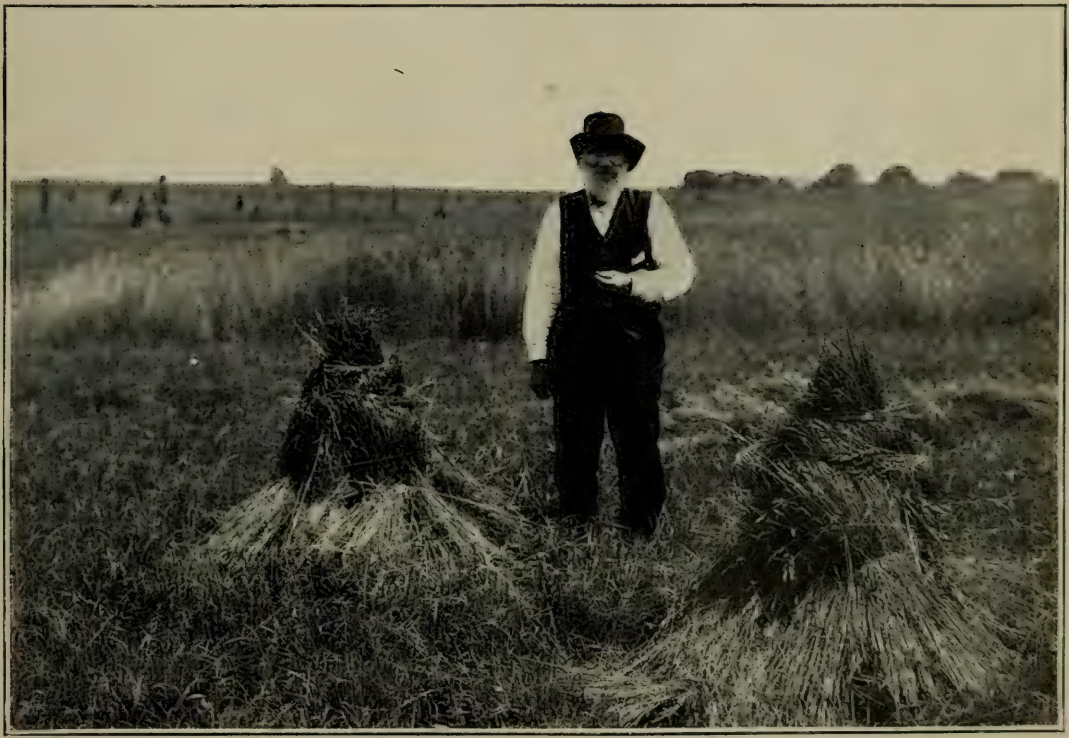


FIG. 2.—METHOD OF SHOCKING ORCHARD GRASS; SHOCKS SHOWING BANDS AT TOP.

HARVESTING THE SEED CROP.

The methods used in harvesting orchard grass seed are practically the same throughout the whole country. In general, harvest begins about June 15 and lasts about ten days, though when there is a large acreage it is often necessary to begin earlier than this, in order to finish before the seed becomes too ripe. An inferior quality results from cutting the seed before it is sufficiently mature, and this seed is quite readily detected by its light-green color. When properly matured the seed is straw colored, and not at all green. A common test to determine whether the seed is at the proper stage for cutting is to beat the heads in the palm of the hand, and if quite a quantity shatters off it is considered ready to cut. To one unfamiliar with the crop it would seem that the waste from shattering would be great.

Orchard grass is harvested with an ordinary grain binder (Pl. I, fig. 1), making as small bundles as possible, in order that they may cure readily. The bundles are placed usually three in a shock and the shocks tied at the top with two bands of straw, one about 8 inches below the other (Pl. I, fig. 2). They are bound in this way so as to make them more stable and to prevent the seed from shattering. The shocks are made small to facilitate handling at the time of thrashing, and so that they may be easily tied at the top with the straw bands. They are left standing from two to four weeks, or until they have had time to cure thoroughly, and are thrashed without stacking. On an average it takes about 5 pounds of twine for 100 bushels of seed. The crop is of such importance that the fence corners and other places that can not be reached with the binder are cut with the cradle and bound into bundles by hand.

When the grass is sufficiently tall it is cut from 12 to 14 inches high, to avoid the low-growing weeds, such as plantain and sorrel, and also clover and bluegrass. Another advantage in high cutting is that it leaves more of the undergrowth to be utilized later for hay or pasture.

THRASHING.

The common grain separator is used for thrashing with the ordinary cylinder and concaves, but with special riddles and with nearly all the wind shut off to prevent too much of the seed from being blown over. In hauling the shocks to the machine, racks with tight beds or with tarpaulins spread over the bottom are used to catch the seed that shatters off, which is usually considerable. This is always heavy seed, and is worth saving. Since the shocks are small, a whole one may be thrown on the rack at one forkful without breaking the bands. This reduces shattering to a minimum. Unless the grass is very weedy the thrashing machine cleans the seed sufficiently for the market, but most of the larger growers have hand fanning mills, which are used when necessary. Seeds like those of redtop are easily blown out, but it is harder to dispose of the bluegrass and some of the weed seeds, such as plantain and whitetop. From the machine the seed is put into 8-bushel bags for shipping. Thrashing costs on an average 8 cents per bushel, with the customary crew furnished.

HANDLING THE AFTERGROWTH.

In cases where orchard grass is cut for seed there is a great difference of opinion as to how the aftergrowth should be handled. It is generally considered that pasturing is not in the least detrimental and even beneficial. As to whether the aftergrowth should be cut for hay is an undecided question. It is a common practice, however, to cut it, due to the fact that it is depended upon largely for hay, since timothy and other hay grasses are not grown to any great extent. After the grass is cut for seed, especially when it is cut sufficiently high, there is always considerable green undergrowth. This continues to grow, and during the latter part of August or about the first of September is at the proper stage to cut for hay. If there is clover present in the aftergrowth it makes a very fair quality of hay and yields from one-half to one ton to the acre. The quality of this hay is not so good as that of the hay made from the first cutting.

While it is a general practice to cut the aftermath during the latter part of August or September, there are some who prefer to cut it as soon as the shocks are removed from the field, as it is believed to be better for the following seed crop if it is cut then. It is the opinion of some that the aftermath should be cut in any event, and consequently if it is not desired for hay it is cut and left on the ground. Others are of the opinion that if it is cut at all it materially injures the next year's crop, especially so if used for hay, as the two cuttings remove a large amount of plant food from the soil without much return.

Judicious pasturing, to say the least, is not detrimental to the field, and in all probability is more or less beneficial. The aftergrowth, which comes on after the seed crop is removed, furnishes grazing until it is covered with snow, and in the more southern sections where the grass is grown lasts nearly the entire winter. Sheep can be very profitably pastured on this aftergrowth and in many cases almost as much money is made from the pasture that it affords the sheep as from the seed crop, on account of the length of time which it will furnish grazing. At present prices sheep are equally as profitable as cattle, if not more so, and can be pastured on orchard grass to much better advantage.

VALUE OF THE STRAW.

There is much difference of opinion regarding the value as a feed for stock of orchard grass straw from which the seed has been thrashed. Some state that it is of almost as much value as the hay, but in general it is thought to be about equal to wheat straw. Its value depends largely on three factors: The state of maturity at the time of cutting; the amount of aftergrowth, including red clover, contained in it, and the success with which it is cured. If the grass is cut before the seed is sufficiently mature to harvest, the straw will be of more value for feed than when it is cut at the proper stage. The undergrowth which is present probably furnishes as much feed as the straw itself, if not more, especially when it contains clover.

It is a common practice to cut the grass as high as possible to avoid the weeds and clover, but if it is short there is necessarily a great deal of undergrowth cut with it. If the grass has not received too much rain while in the shock and is stacked properly or put into a barn or shed at the time of thrashing, the straw will be of much more value than if carelessly handled. In general, there is little attention paid to the stacking of the straw, and it is commonly left in piles just as they are made by the machine. When utilized for forage it is fed to horses or cattle, usually the latter, but is of very little value for sheep. Aside from its value as a feed, straw may be used for seeding meadows, as previously described. It should never be used for this purpose, however, unless thoroughly free from weeds.

WEEDS IN ORCHARD GRASS SEED FIELDS.

The weeds which are most troublesome in orchard grass fields, especially in sections where seed is produced, are whitetop (*Erigeron annuus*), red sorrel (*Rumex acetosella*), oxeye daisy (*Chrysanthemum leucanthemum*), milfoil (*Achillea millefolium*), and the plantains (*Plantago lanceolata* and *P. aristata*). Most growers pay much attention to keeping these weeds out of their fields and go to considerable expense for labor to mow them or cut them out with a hoe just before harvest. A method which is now quite commonly used and which is most effective and practicable is to pasture the fields with sheep. This is an excellent practice and it is comparatively easy to distinguish at harvest time between fields that have been pastured in this way and those that have not by the absence of weeds in the former. Such good results have been obtained by pasturing sheep on the grass to keep down the weeds that farmers are raising more sheep than formerly and are growing cleaner seed. It is a common practice to turn the sheep on in the spring as soon as the grass begins to grow and allow them to remain until the early part of May. As the grass advances toward maturity the sheep eat very little of it, but graze mostly upon the weeds and undergrowth, and especially on the whitetop, which is one of the worst weeds present, if not the worst. They do little damage to the field when it is dry and in wet weather they are kept off, as they drag down too much of the grass. Although it is the custom to turn the sheep out of the fields in the early part of May, some of the most successful growers leave them in until nearly harvest time. It is not uncommon to see sheep in fields that are ready to harvest. When it is possible to do so the fields should be pastured late, as this practice is more effective in keeping down the weeds, since it takes them but a short time to make sufficient growth to interfere with the cleaning of the seed. Cattle are sometimes pastured on fields that are intended for seed, but they tramp down too much of the grass and are not as satisfactory for this purpose as sheep.

OTHER GRASSES IN FIELDS INTENDED FOR SEED.

Much has recently been said regarding the presence of seeds of other grasses in orchard grass seed. Those which appear to be the most common are meadow fescue (*Festuca pratensis*) and the rye-grasses (*Lolium perenne* and *Lolium italicum*). The seed of these grasses is much heavier, but it resembles orchard grass seed to such an extent that its presence is not readily detected. Meadow fescue and rye-grass have very much the same appearance, but there is no difficulty in distinguishing them from orchard grass, as their seed habits and general habits of growth are different. If these grasses were present in considerable quantities in the orchard grass fields in Kentucky, Indiana, and western Virginia, where practically our entire supply of seed is produced, the presence of their seed in orchard grass seed could be readily accounted for. The orchard grass fields in these sections, however, are almost entirely free from other grasses, and only in a very few cases are there any others present, with the exception of some Kentucky bluegrass (*Poa pratensis*) and Canada bluegrass (*Poa compressa*) and a little cheat (*Bromus secalinus*) and redtop (*Agrostis alba*). Bluegrass and redtop, especially the former, come in naturally in the older fields, and cheat is present practically only the first year, due to its having been in the wheat which just preceded the grass crop. The quantity of meadow fescue and rye-grasses in these fields is insignificant, and there are only a very few cases where these grasses are present at all. The total percentage of other grasses in orchard grass throughout the whole seed-producing section is so small as to be hardly worthy of consideration, and statements made to the effect that the presence of their seed in orchard grass seed is due to the fact that they are grown with the orchard grass and can not be separated from it are entirely without foundation. Farmers in general are extremely careful to keep their orchard grass fields free from other grasses, for the reason that their seeds are readily detected by buyers and as a consequence the seed invariably sells at a lower price. It is a comparatively easy matter for seed growers to have pure seed for their own sowing, and there would be absolutely no advantage to them in growing meadow fescue, rye-grasses, and other grasses with orchard grass.

SUMMARY.

Orchard grass is of considerable value for early and late pasture, and in the southern part of the region where it is grown can be pastured nearly the entire year. When used for pasture, bluegrass and white clover are commonly grown with it.

Orchard grass hay is of value, especially when it contains red clover, and can be fed to horses successfully. It is a good forage for cattle that are being fattened for market.

When grown for seed, orchard grass is a profitable crop, as it yields on an average 10 to 12 bushels to the acre and sells for $1.25 a bushel. Aside from securing a crop of seed, the aftergrowth may be either pastured or cut for hay. This aftergrowth makes a very fair quality of hay, and when cut during the latter part of August or September gives a yield of from one-half to one ton to the acre.

Although not previously stated, orchard grass is quite valuable for binding soils, and on rough land that washes badly it can be used for this purpose effectively.

Orchard grass may be seeded either in the autumn or spring with about equally good results. Spring seeding, however, seems to be the most common practice. In most cases it is sown broadcast on fall wheat on fields that have been in wheat the previous year. One bushel of seed is a sufficient quantity when the grass is to be grown for seed. When grown for hay or pasture, more than this should be used. A good catch may be obtained by scattering the straw evenly and thinly on fall wheat in early spring.

Red clover can be profitably sown with orchard grass at the rate of 1 bushel to 5 or 7 acres. Mixtures of orchard grass with other grasses, especially with tall meadow oat-grass and meadow fescue, are giving good results for hay and pasture in places where they are being tried.

The average life of an orchard grass meadow is from five to seven years, after which it is plowed up, usually late in the fall, and put into corn.

Orchard grass is harvested for seed from about June 15 to June 25. It is cut with an ordinary grain binder and bound into small bundles, requiring about 5 pounds of twine to 100 bushels of seed. The bundles are put three in a shock and bound at the top with a band of grass to make them more stable and to prevent the seed from shattering. Thrashing is done from the shock after the grass has stood in the field from two to four weeks, with an ordinary separator, using special riddles.

Sheep are pastured on orchard grass in the spring to keep down the weeds. They are sometimes allowed to remain in the field until nearly time to harvest. This practice is very effective in keeping clean the fields that are grown for seed.

The percentage of meadow fescue, rye-grasses, and other grasses in orchard grass fields that are grown for seed is so small as not to be worthy of consideration.

O

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART VII.

B. T. GALLOWAY, *Chief of Bureau.*

THE EFFECT OF COPPER UPON WATER BACTERIA.

BY

KARL F. KELLERMAN,
Physiologist in Charge of Soil Bacteriology and
Water Purification Investigations,

AND

T. D. BECKWITH,
Scientific Assistant.

Issued October 20, 1906.

-6.
239414
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

Page
Introduction 5
Resistance of various bacteria 7
Effect of carbon dioxid on viability of *Bacillus coli* and *Bacillus typhi* 12
Copper sulfate and filtration 17

THE EFFECT OF COPPER UPON WATER BACTERIA.[a]

INTRODUCTION.

Of the many methods of chemical treatment for water purification, the copper method has recently received the most attention. The use of this metal, or its salts, was urged primarily[b] for the eradication or control of polluting algæ, tho popular attention has been directed more particularly to the various results obtained in destroying the typhoid bacillus.

The discrepancies between laboratory results of some of the investigators of this phase of the subject have deterred many engineers and sanitarians from conducting important tests of the value of copper under emergency or epidemic conditions. These discrepancies are perhaps in some cases due to reasons which are taken up later in this bulletin, and in some cases to the lack of comprehension of the essential difference between treatment of drinking water which contains relatively little albuminoid matter[c] and treatment of bouillons or emulsions.[d]

---

[a] The copper method for controlling algal pollution can no longer be considered in an experimental stage. The accumulation of results of treatments constantly made under the direct supervision of officials of the Department of Agriculture and the numerous results reported to this Department by independent experimenters render further discussion of this question superfluous. The caution should be reiterated, however, that no rule for determining the amount of copper sulfate to be added can be given, and each body of water must be treated in the light of its special conditions. This caution is eminently applicable to copper treatment of a water supply for bactericidal purposes, and, as Mr. Kellerman and Mr. Beckwith have shown in their recent work, the problem of using dilute solutions of copper for destroying *Bacillus coli* and *Bacillus typhi* in water is a rather complicated one. Pertinent conditions must be understood thoroly before an application of copper can be safely advised, and whether an emergency treatment of an unfiltered and contaminated water, or a continuous treatment of a filtered water supply, or a treatment of a sewage effluent is contemplated the work should be supervised by an expert.—A. F. Woods, *Pathologist and Physiologist, Acting Chief of Bureau.*

[b] Buls. 64 and 76, Bureau of Plant Industry, U. S. Dept. of Agriculture.

[c] See also Buls. 64 and 76, Bureau of Plant Industry, U. S. Dept. of Agriculture.

[d] A case in point is a paper by Dr. J. B. Thomas, Report on the Action of Various Substances on Pure Cultures of the Amœba Dysenteriæ. (Amer. Jour. Med. Sci., vol. 131, No. 1, Jan., 1906, p. 116.) "Uniform suspensions of the amœba were made by pouring 4 cc. of distilled sterile water over the surface of a 48-hour slant agar culture of the amœba and cholera spirillum, scraping off the surface growth and mixing with the matter by means of a platinum wire, and pouring the resultant emulsion into a sterile test tube; 4 cc. of the antiseptic solution (in double strength)

In spite of the fact that the field results of several experimenters[a] have apparently established the point that copper sulfate will not destroy ordinary water bacteria at concentrations fatal to the colon and typhoid bacilli, the somewhat fanciful objection has been suggested to chemical treatment of any kind, and to copper treatment in particular, that bacteria desirable for oxidation of organic matter and other beneficial changes in a water supply might be injured equally with the typhoid bacteria, and thus a treated water be more potentially dangerous than an untreated water known to contain typhoid organisms; in other words, that many bacteria which could be of decided benefit in a slightly polluted water supply might be eradicated by copper treatment and that in this way the fractional sterilization of a reservoir by copper might pave the way for a more dangerous contamination.

Investigations of these and other points have been undertaken, and it is believed that valuable data have been obtained, applicable to copper treatment for algæ, to emergency treatment for typhoid, and to copper treatment in connection with filtration. The copper treatment of sewage may be influenced by the same conditions that bear upon the effect of copper treatment of water. For the present, however, the investigations of Johnson,[b] at the Columbus, Ohio, sewage testing station may be considered sufficiently accurate for practical purposes.

---

to be tested was then added to the 4 cc. emulsion of amœbæ, thus making a fairly uniform emulsion of 8 cc. of liquid to one 48-hour slant culture, the mixture containing a definite amount of the chemical to be tested. * * * It would appear from the above results that it would be disastrous to rely on the action of copper containers to purify water infected with amœbæ or cholera."

[a] Caird. Copper Sulphate Results. Paper read at meeting of American Water Works Association, Boston, Mass., July 10–14, 1906.

Jackson. Journal New England Water Works Association, vol. 19, 1905, pp. 563–568.

Hollis. Journal New England Water Works Association, vol. 19, 1905, pp. 571–572.

Stokes and Thomas. The Effect of Copper Sulphate upon the Bacteriological and Chemical Constituents of Large Bodies of Water. Public Health Papers and Reports, American Public Health Association, vol. 31, part 1, 1905, pp. 75–90.

[b] The Copper Treatment of Sewage Effluents. Report on Sewage Purification at Columbus, Ohio, 1905.

"Available data indicate that the removal by either process of applied pathogenic and nonpathogenic bacteria is in fairly direct proportion, generally speaking, although, of course, saprophytic bacteria may multiply within the tanks or filters, so as to obscure the true removal. Under some conditions it might be advantageous to employ a germicide, such as sulphate of copper, as a final treatment for sewage effluents of doubtful bacterial purity." (P. 471.)

"Independent of the question of complete sterilization as touched upon * * * it may be that there is a field of usefulness in some places for copper sulphate or other germicidal chemical in the treatment of coarse-grain filter effluents, in order to bring them from a bacterial or hygienic standpoint to a degree of purity strictly comparable with that of the effluent of ordinary intermittent sand filters." (P. 479.)

RESISTANCE OF VARIOUS BACTERIA.

Several species of bacteria occurring commonly in Potomac River water have been isolated, and comparative tests have been carried on with these bacteria and with the colon bacillus. An examination of the tables showing the exact results of these tests indicates clearly that no danger to most of the common saprophytic bacteria can be expected from using concentrations of copper sufficiently strong to destroy *Bacillus coli*. To allow as little variation as possible in the different tests all experiments were carried out in triple-distilled water. This will probably explain the sensitiveness of most of the bacteria to copper solutions, for, as Gildersleeve[a] has stated, "The resistance of bacteria washed in distilled water is lessened, due in all probability to the fact that some of the slimy substance which surrounds the bacterial cell and protects it to some extent from the action of detrimental agencies is removed." For purposes of comparison the table showing the action of copper sulfate on various bacteria in tap water, published by Gildersleeve,[b] is reproduced below.

Organism.	Dilution.	Average number to the cubic centimeter in control.	Percentage destroyed in hours specified.												
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	24.
B. typhosus	1: 250,000	110,000	100	....	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1: 500,000	100,000	99	100	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1:1,000,000	140,000	78	100	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1:1,500,000	120,000	50	85	99	100	....	.....	.....	....	.....	....	....	.....	....
	1:2,000,000	130,000	4	7	55	80	82	87	87	93	98	100	....	.....	....
B. coli communis	1: 250,000	105,000	100	....	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1: 500,000	120,000	99	100	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1:1,000,000	99,000	80	99	100	.....	....	.....	.....	....	.....	....	....	.....	....
	1:1,500,000	150,000	87	95	99	100	....	.....	.....	....	.....	....	....	.....	....
	1:2,000,000	110,000	8	10	14	27	50	85	90	92	93	93	95	98	100
B. dysenteriæ	1: 250,000	11,500	95	100	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1: 500,000	120,000	40	95	97	100	....	.....	.....	....	.....	....	....	.....	....
	1:1,000,000	72,000	31	50	62	85	99	99+	100	....	.....	....	....	.....	....
	1:1,500,000	12,400	20	30	40	42	60	70	75	81	85	87	90	91	100
	1:2,000,000	13,600	20	20	25	30	30	45	60	62	62	68	71	75	98
B. cloacæ	1: 250,000	92,000	90	99	100	.....	....	.....	.....	....	.....	....	....	.....	....
	1: 500,000	86,000	68	90	99	100	....	.....	.....	....	.....	....	....	.....	....
	1:1,000,000	101,000	33	85	89	96	96	99	100	....	.....	....	....	.....	....
	1:1,500,000	89,000	5	10	30	40	70	85	95	98	98	99	100	.....	...
	1:2,000,000	94,500	3	10	31	40	80	83	85	88	91	91	93	97	100
B. proteus vulgaris	1: 250,000	115,000	93	100	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1: 500,000	106,000	65	92	98	100	....	.....	.....	....	.....	....	....	.....	....
	1:1,000,000	111,000	28	51	82	90	95	98	100	....	.....	....	....	.....	....
	1:1,500,000	99,000	10	18	27	42	69	90	93	98	99+	100	....	.....	....
	1:2,000,000	118,000	0	12	22	36	51	65	78	80	85	88	92	95	100
B. prodigiosus	1: 250,000	102,000	95	99	99	99+	100	.....	.....	....	.....	....	....	.....	....
	1: 500,000	109,900	15	26	80	95	97	99	99+	100	.....	....	....	.....	....
	1:1,000,000	110,000	9	11	16	33	33	45	47	61	63	69	....	.....	93
	1:1,500,000	107,000	4	12	17	30	38	46	46	48	51	52	60	61	92
	1:2,000,000	98,000	0	1	8	8	10	11	15	30	38	41	43	50	88
Staphylococcus pyogenes aureus	1: 250,000	92,000	99	100	....	.....	....	.....	.....	....	.....	....	....	.....	....
	1: 500,000	88,000	50	70	90	100	....	.....	.....	....	.....	....	....	.....	....
	1:1,000,000	86,000	15	30	30	70	78	85	97	99	99	100	....	.....	....
	1:1,500,000	100,000	8	22	28	96	58	69	85	93	95	99	100	.....	....
	1:2,000,000	95,000	1	8	10	30	50	64	79	82	85	98	99	99+	100

---

[a] Studies on the Bactericidal Action of Copper on Organisms in Water. American Journal of Medical Science, vol. 129, 1905, p. 754.

[b] Op. cit., p. 759.

The figures in this table are rather surprising in connection with the statement that "very little difference was found between distilled and filtered water used in the laboratory." The similarity here of the action of copper in distilled and filtered tap water, contrasted with the marked difference in the action of distilled and filtered tap water in Washington, emphasizes a point previously mentioned,[a] that the water itself deserves as careful a study as do the organisms contained therein. This is suggested again in Phelps's[b] report showing that with either hard or turbid waters the germicidal efficiency of metallic copper is much lessened. Again, in view of the high toxicity that investigators have reported with copper in Philadelphia tap water, it seems necessary to assume that this water either is peculiarly favorable to maintaining the metal in a toxic state, or, what seems equally probable, for rendering the bacteria unusually sensitive.

The results of our own experiments are given in the following tables. All the experiments, unless otherwise indicated, were conducted in Weber resistance glass test tubes, each containing 10 c. c. of water triple distilled from glass, portions of which had been treated previously with the desired amount of copper sulfate. All tubes were inoculated with a 2 mm. loop of the proper organism. The temperature during each experiment varied from 18° to 22° C.

Table I.—*Effect of copper sulfate upon Bacillus mycoides.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	105	90	590	310	70	250	90
6 hours	80	1	20	80	15	35	15
24 hours	185	10	130	110	40	20	50

Table II.—*Effect of copper sulfate upon Bacillus megatherium.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	70	55	45	30	90	15	50
2 hours	50	10	25	30	40	0	20
6 hours	40	15	20	10	40	1	15
24 hours	200	10	15	5	10	2	10

---

[a] Bul. 76, Bureau of Plant Industry, U. S. Dept. of Agriculture, p. 12; and Kellerman, Journal New England Water Works Association, vol. 19, 1905, p. 536.

[b] Journal New England Water Works Association, vol. 19, 1905, pp. 537–539.

TABLE III.—*Effect of copper sulfate upon Bacillus mesentericus.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	300	380	400	520	280	440	470
2 hours	280	170	310	440	260	340	360
6 hours	430	10	290	320	250	310	390
24 hours	1,350	0	0	530	3	4	30

TABLE IV.—*Effect of copper sulfate upon Bacillus mesentericus fuscus.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	30	40	25	25	50	20	30
2 hours	0	5	50	10	3	0	1
6 hours	2	1	30	5	5	2	1
24 hours	70	110	70	45	0	10	80

TABLE V.—*Effect of copper sulfate upon Streptococcus pyogenes.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	180	875	875	300	250	90	180
2 hours	210	0	0	290	180	180	180
6 hours	140	0	0	280	230	240	160
24 hours	35	0	0	390	150	10	20

TABLE VI.—*Effect of copper sulfate upon Bacillus subtilis.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	310	80	20	130	85	100	30
2 hours	220	1	3	30	120	70	10
6 hours	330	1	1	25	85	50	2
24 hours	2,800	1	0	30	70	65	0

TABLE VII.—*Effect of copper sulfate upon Bacillus prodigiosus.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	350	450	400	1,050	22,000	2,000	1,800
2 hours	750	65	180	1,700	1,350	2,050	1,550
6 hours	1,250	4	0	2	0	550	200
24 hours	925	0	0	0	0	0	0

TABLE VIII.—*Effect of copper sulfate upon Bacillus liquifaciens phosphorescens.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	16,500	3,400	2,400	16,000	4,500	10,400	13,000
2 hours	15,800	0	1	0	5	2,900	7,300
6 hours	23,000	0	0	0	0	640	7,000
24 hours	36,000	0	0	0	0	60	5,300

TABLE IX.—*Effect of copper sulfate upon pink yeast.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	310	550	100	110	100	220	108
2 hours	150	5	1	0	1	65	85
6 hours	70	0	0	0	1	3	50
24 hours	90	0	0	0	0	1	30

TABLE X.—*Effect of copper sulfate upon Bacillus coli.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.	2,000,000 parts of water.	3,000,000 parts of water.	4,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	2,650	2,300	3,100	2,700	2,250	1,800	1,770
2 hours	2,350	1,650	2,650	2,000	1,650	1,850	1,850
6 hours	2,300	0	0	95	210	850	1,070
24 hours	6,300	0	0	0	0	0	65

TABLE XI.—*Effect of copper sulfate upon sulfur yellow bacillus.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	2.800	40	3,100	2,800	4,100	860	1,300
2 hours	2,000	0	0	0	280	1	2
6 hours	1,500	0	0	0	0	0	0
24 hours	24,000	0	0	0	0	0	0

TABLE XII.—*Effect of copper sulfate upon Pseudomonas radicicola (soy).*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	1,900	520	1,300	2,800	650	520	3,100
2 hours	1,800	0	0	45	0	25	1,100
6 hours	2,100	0	0	0	0	0	30
24 hours	18,000	0	0	0	0	0	0

TABLE XIII.—*Effect of copper sulfate upon Bacillus sublanatus.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	12,500	780	2,700	2,100	1,100	2,100	1,500
2 hours	12,000	0	0	0	0	35	190
6 hours	12,500	0	0	0	0	0	80
24 hours	40,000	0	0	0	1	0	0

TABLE XIV.—*Effect of copper sulfate upon Micrococcus radians.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	1,200	2,700	10,500	1,700	3,800	2,500	2,800
2 hours	1,200	1	0	1	20	85	10
6 hours	1,400	0	0	0	0	0	1
24 hours	1,900	0	0	0	0	0	0

TABLE XV.—*Effect of copper sulfate upon Pseudomonas radicicola (alfalfa).*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	270	300	330	425	3,700	700	290
2 hours	210	0	0	0	0	0	0
6 hours	220	0	0	0	0	0	0
24 hours	1,175	0	0	0	0	0	0

TABLE XVI.—*Effect of copper sulfate upon Bacillus violaceus laurentius.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	7,200	120	480	740	470	210	520
2 hours	5,300	0	0	0	0	1	25
6 hours	6,800	0	0	0	0	0	0
24 hours	40,000	0	0	0	0	0	0

TABLE XVII.—*Effect of copper sulfate upon Pseudomonas amethystina.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	140	540	90	70	580	670	660
2 hours	190	0	0	1	3	3	15
6 hours	240	0	0	0	0	1	1
24 hours	....	0	0	0	0	0	0

TABLE XVIII.—*Effect of copper sulfate upon Bacillus caudatus.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	875	60	680	2,100	15	70
2 hours	350	0	0	1	0	0
6 hours	400	0	0	1	0	0
24 hours	9,000	0	0	0	0	0

TABLE XIX.—*Effect of copper sulfate upon Bacillus rubrum.*

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—					
		10,000 parts of water.	25,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	175	10	30	225	90	210	135
2 hours	195	0	0	90	0	0	0
6 hours	50	0	0	5	0	0	0
24 hours	1,050	0	0	5	0	0	0

EFFECT OF CARBON DIOXID ON VIABILITY OF BACILLUS COLI AND BACILLUS TYPHI.

A careful study of the gas content of both tap and triple distilled water has shown that for the typhoid and colon bacilli the presence of carbon dioxid in the water is associated with heightened resistance to toxic agents, such as solutions of copper salts, precipitated copper salts, and copper metal. This is the more strange when one considers that the presence of carbon dioxid in water causes the copper to remain in solution, and in case of insoluble copper, either precipitated or metallic, the carbon dioxid serves to bring a considerable amount of copper into solution. It should be noted, however, that water heavily saturated with carbon dioxid is toxic to *Bacillus coli* and *Bacillus typhi.*

A series of experiments designed to test the effect of carbon dioxid on *Bacillus coli*, the various conditions of triple distilled water with and without copper, triple distilled water plus calcium carbonate with and without copper, and tap water with and without copper are tabulated below.

TABLE XX.—*Toxicity of copper sulfate to Bacillus coli in the absence of carbon dioxid.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	6,800	1,400	2,300	2,200	900	3,500
2 hours	5,100	0	0	0	2	80

---

[1] Experiment conducted in Weber resistance glass test tubes each containing 10 c. c. of water triple distilled from glass, portions of which had been treated previously with the desired amount of copper sulfate. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

TABLE XXI.—*Effect of carbon dioxid upon toxicity of copper sulfate to Bacillus coli.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	9,200	8,200	5,800	11,600	7,500	6,200
2 hours	2,000	0	110	38	900	350

[1] Experiment conducted in Weber resistance glass test tubes, each containing 10 c. c. of water triple distilled from glass, portions of which had been treated previously with the desired amount of copper sulfate. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

TABLE XXII.—*Effect of water containing calcium monocarbonate and various quantities of copper sulfate upon Bacillus coli.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	2,950	3,510	2,670	3,150	4,290	3,760
6 hours	240	0	0	0	105	80
24 hours	5	0	0	0	0	0

[1] Various dilutions of copper sulfate were tubed in Weber resistance glass, thoroly boiled, a small measured quantity of calcium carbonate added to each tube, and these solutions cooled and kept in a Novy jar in an atmosphere free of carbon dioxid. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from the Bureau of Animal Industry and isolated from hog. The temperature during this experiment varied from 18° to 22° C.

TABLE XXIII.—*Effect of carbon dioxid content of water containing calcium carbonate and various quantities of copper sulfate upon Bacillus coli.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	4,650	4,730	3,850	3,980	4,100	4,470
6 hours	4,500	0	0	5	415	620
24 hours	5,200	0	0	0	15	60

[1] Various dilutions of copper sulfate were tubed in Weber resistance glass, thoroly boiled, a small measured quantity of calcium carbonate added to each tube, and these solutions cooled and kept in a Novy jar in an atmosphere composed largely of carbon dioxid. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from the Bureau of Animal Industry and isolated from hog. The temperature during this experiment varied from 18° to 22° C.

TABLE XXIV.—*Toxicity of copper sulfate to Bacillus coli in tap water free of carbon dioxid.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	6,300	7,600	6,000	1,050	4,800	5,200
2 hours	1,500	0	0	0	Lost.	60
6 hours	280	0	0	0	0	0
24 hours	0	0	0	0	0	0

[1] Experiment conducted in Weber resistance glass test tubes, each containing 10 c. c. of Potomac tap water, portions of which had been treated previously with the desired amount of copper sulfate. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from the Bureau of Animal Industry, isolated from hog. The temperature during this experiment varied from 18° to 22° C.

TABLE XXV.—*Toxicity of copper sulfate to Bacillus coli in tap water free of carbon dioxid.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	4,600	1,800	4,800	3,700	4,500	4,000
2 hours	1,450	0	0	20	80	100
6 hours	1,500	0	0	0	5	2
24 hours	250	0	0	0	0	0

[1] Experiment conducted in Weber resistance glass test tubes, each containing 10 c. c. of Potomac tap water, portions of which had been treated previously with the desired amount of copper sulfate. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

TABLE XXVI.—*Effect of carbon dioxid upon toxicity of copper sulfate to Bacillus coli.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	4,200	4,000	9,800	1,270	5,100	1,100
2 hours	2,800	10	0	0	110	260
6 hours	1,460	15	15	20	10	35
24 hours	1,540	0	0	0	0	0

[1] Experiment conducted in Weber resistance glass test tubes, each containing 10 c. c. of Potomac tap water, portions of which had been treated previously with the desired amount of copper sulfate. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from the Bureau of Animal Industry, isolated from hog. The temperature during this experiment varied from 18° to 22° C.

TABLE XXVII.—*Effect of carbon dioxid upon toxicity of copper sulfate to Bacillus coli.*[1]

Duration of exposure to action of copper sulfate.	Check.	1 part copper sulfate to—				
		10,000 parts of water.	50,000 parts of water.	100,000 parts of water.	500,000 parts of water.	1,000,000 parts of water.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	3,800	3,000	8,500	5,200	4,400	5,500
2 hours	2,300	0	5	15	2,150	1,500
6 hours	1,600	10	12	10	120	100
24 hours	3,500	0	0	10	35	0

[1] Experiment conducted in Weber resistance glass test tubes, each containing 10 c. c. of Potomac tap water, portions of which had been treated previously with the desired amount of copper sulfate. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

An examination of the foregoing tables shows that with the three types of water the presence of carbon dioxid increases the resistance of the bacilli in question. In the solution containing monocarbonate of lime and copper sulfate the bacteria are extremely sensitive, even the bacteria in the check solutions dying rapidly, while in the solutions charged with carbon dioxid the bacteria were able to persist in considerable numbers in the dilute copper solutions in spite of the fact that most of the copper must have remained in solution. This point is interesting in connection with the work of Engels,[a] who reports a rather high toxicity for calcium chlorid, and of Pfuhl,[a] who suggests a calcium salt—milk of lime—for water sterilization. The use of lime or a similar agent may be highly desirable in connection with treating a contaminated reservoir with copper, tho the inferior germicidal power of lime makes it improbable that the latter alone could be used safely.

---

[a] Weitere Studien über die Sterilization von Trinkwasser auf chemischen Wege. Centralbl. f. Bakt., Parasit., u. Infekt., vol. 32 Orig., 1902, pp. 495–521.

In regard to chemical water analysis, it seems probable that the determination of carbon dioxid or the determination of monocarbonate and bicarbonate alkalinity may have importance hitherto unrecognized, and the variations in the longevity determinations of *Bacillus coli* and *Bacillus typhi* may be due in part to the mineral constituents of a water, in part to methods of experimentation, and in part to the carbon dioxid content. Extended field tests must be made before generalizations on the possible effect of the gas content of a water supply can be determined.

The carbon dioxid content of a water may possibly explain the peculiar results obtained by Clark and Gage.[b] They have reported practically no toxic action from metallic copper, or at least very little difference in the action of metallic copper, iron, tin, zinc, and lead. Their figures are rather misleading because of the great number of days the experiments were carried on, and, as Phelps[c] has shown, metallic copper is coated with some insoluble substance after a few days' exposure to Boston tap water and no longer has great toxic action. The lack of toxicity of metallic copper and the similarity of its action to the action of other metals, as reported by Clark and Gage, is entirely at variance with the work of Kraemer,[d] Pennington,[e] Gildersleeve,[f] Stewart,[g] and Moore and Kellerman.[h] Investigators generally have agreed that it would be possible to practically sterilize drinking water by exposing it to the action of clean metallic copper.[a] Perhaps this opinion should be qualified by adding that the action is more rapid if the water contains no free carbon dioxid, altho the following tables show only slight differences between the toxicity of metals because of the presence or absence of carbon dioxid.

---

[a] Über die Disinfection der Typhus and Cholera-ausleerungen mit Kalk. Zeitschr. f. Hyg. u. Infekt., vol. 6-s, 1889, pp. 97-104.

[b] The Use of Copper Sulphate in Water Filtration. Journal of Infectious Diseases. Supplement No. 2, February, 1906, pp. 172-174.

[c] Experiments on the Storage of Typhoid Infected Water in Copper Canteens. Public Health Papers and Reports, American Public Health Association, vol. 31, part 1, 1905, pp. 75-90.

[d] Copper Treatment of Water. American Journal of Pharmacy, vol. 76, December, 1904, pp. 574-579.

The Use of Copper in Destroying Typhoid Organisms and the Effects of Copper on Man. American Journal of Pharmacy, vol. 77, June, 1905, pp. 265-181.

[e] The Action of Electrically Charged Copper Upon Certain Organisms in Water. American Journal of Medical Science, vol. 129, 1905, pp. 751-754.

[f] Studies on the Bactericidal Action of Copper on Organisms in Water. American Journal of Medical Science, vol. 129, 1905, pp. 754-760.

[g] A Study of the Action of Colloidal Solutions of Copper upon Bacillus Typhosus, American Journal of Medical Science, vol. 129, 1905, pp. 760-769.

[h] Buls. 64 and 76, Bureau of Plant Industry, U. S. Dept. of Agriculture.

TABLE XXVIII.—*Effect of carbon dioxid upon toxicity of metals to Bacillus coli.*[1]

Duration of exposure to action of metals.	Check.	Copper.	Iron.[2]	Zinc.	Lead.	Tin.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	3,700	1,100	3,300	3,050	3,700	3,500
4 hours	440	75	30	125	275	410
8 hours	305	3	3	30	120	190

[1] Experiment conducted in Weber resistance glass test tubes, each containing 10 c. c. of water triple distilled from glass, to portions of which were added sterile blocks of the proper metals, each having approximately 2 sq. cm. surface area. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

[2] Iron impure and presumably more toxic than pure iron. (See Table No. XXII.)

TABLE XXIX.—*Toxicity of metals to Bacillus coli in the absence of carbon dioxid.*[1]

Duration of exposure to action of metals.	Check.	Copper.	Iron.[2]	Zinc.	Lead.	Tin.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	2,950	2,350	1,200	1,450	1,300	1,600
4 hours	965	10	10	65	40	770
8 hours	740	0	0	5	5	700

[1] Experiment conducted in Weber resistance glass test tubes, each containing 10 c. c. of water triple distilled from glass, to portions of which were added sterile blocks of the proper metals, each having approximately 2 sq. cms. surface area. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

[2] Iron impure and presumably more toxic than pure iron. (See Table No. XXII.)

---

[a] There is a seeming discrepancy in this statement due to the fact that Mr. Earle B. Phelps, assistant hydrographer, U. S. Geological Survey, has carried on experiments on the storage of typhoid infected water in copper canteens, some results of which, with conclusions of a nature unfavorable to the use of metallic copper in practically sterilizing water, were issued in a press circular of the Geological Survey. A quotation from Mr. Phelps's paper paralleled with a quotation from Bureau of Plant Industry Bulletin No. 76 shows clearly that Mr. Phelps's work is a corroboration instead of a contradiction of the fact reported in Bulletin No. 76 that metallic copper has a high germicidal value. Mr. Phelps has stated: "The fact that organisms do survive the copper treatment even in small numbers [Per cent reduction usually over 99.999.—K. F. K.] seems, in the writer's view, to lessen considerably the value of the canteen as a safeguard against typhoid infection. A second point of interest is the fact that the efficiency of the canteen decreases as time goes on, probably owing to the accumulation on the surface of the copper of a film of basic carbonate or other insoluble copper compound." A paragraph from Bureau of Plant Industry Bulletin No. 76 reads as follows: "Complete sterilization is a standard to which even the best filters seldom attain, and under the most unfavorable conditions the reduction in the number of bacteria in water exposed to the action of metallic copper for twelve hours will be approximately as great as filtered water. The copper must be kept clean, not, as is popularly supposed, to protect the consumer from copper poisoning, but because it is possible for the metal to become so coated with foreign substances that there is no longer any contact of copper and water, and hence no antiseptic action."

To determine whether the peculiar variation in the germicidal power of solutions or metals is due to the use of ordinary laboratory glassware made of a rather soluble glass instead of carefully selected highly insoluble glass, a parallel series in good and poor glass was carried[1] on. The following tables show the slight difference in results:

TABLE XXX.—*Effect of glass upon toxicity of metals to Bacillus coli.*[1]

Duration of exposure to action of metals.	Check.	Copper.	Iron.	Zinc.	Lead.	Tin.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	2,600	1,925	1,850	2,450	2,600	3,100
2 hours	2,650	775	2,100	715	2,800	2,300
6 hours	2,700	525	2,350	70	2,450	4,200
24 hours	28,000	15	4,350	1	13,750	12,000

[1] Experiment conducted in ordinary glass test tubes each containing 10 c. c. of water triple distilled from glass, to portions of which were added sterile blocks of the proper metals, each having approximately 2 sq. cm. surface area. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

TABLE XXXI.—*Effect of glass upon toxicity of metals to Bacillus coli.*[1]

Duration of exposure to action of metals.	Check.	Copper.	Iron.	Zinc.	Lead.	Tin.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	2,300	4,825	4,750	2,400	2,800	3,900
2 hours	1,572	975	2,400	200	1,800	3,600
6 hours	1,400	190	3,050	20	2,000	3,850
24 hours	10,825	1	6,700	1	19,000	14,000

[1] Experiment conducted in Weber resistance glass test tubes each containing 10 c. c. of water triple distilled from glass, to portions of which were added sterile blocks of the proper metals, each having approximately 2 sq. cm. surface area. All tubes inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

COPPER SULFATE AND FILTRATION.

The use of copper sulfate in connection with filtration has been mentioned in previous bulletins. Further experiments in this field show that in mechanical filtration with alum it is necessary to limit the use of copper sulfate to treatment some hours before coagulation. When solutions of aluminum sulfate and copper sulfate are mixt and alkali or hard water is added in quantities sufficient to cause precipitation the copper is coagulated at once, while the aluminum is deposited on the copper and incloses it, with the result that the copper-alum coagulum is no more toxic than is the pure alum coagulum. When copper and iron salts are precipitated together the reverse of this seems to take place and the precipitate retains its toxic properties.[a]

---

[a] See also H. W. Clark, Sulphate of Alumina as a Germicide. Thirty-sixth Annual Report of State Board of Health of Massachusetts, 1904, p. 288.

The following table shows the various combinations of precipitates tested and the exact results:

TABLE XXXII.—*Toxicity of combined precipitates to Bacillus coli.*[1]

Duration of exposure to action of precipitate.	Check.	Copper hydrate.	Iron hydrate.	Aluminum hydrate.	Copper and iron hydrate.	Copper and aluminum hydrate.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	2,250	1,525	645	7,750	3,450	1,750
2 hours	675	0	230	1,800	25	320
6 hours	465	0	230	195	0	15
24 hours	165	0	230	5	0	1

[1] Experiment conducted in 100 c.c. Jena glass flasks, each containing 15 mg. of the proper precipitate. All flasks inoculated with a 2 mm. loop of culture of *Bacillus coli* received from Prof. Theobald Smith. The temperature during this experiment varied from 18° to 22° C.

TABLE XXXIII.—*Toxicity of combined precipitates to Bacillus coli.*[1]

Duration of exposure to action of precipitate.	Check.	Copper hydrate.	Iron hydrate.	Aluminum hydrate.	Copper and iron hydrate.	Copper and aluminum hydrate.
	Colonies.	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*	*Colonies.*
0 hour	3,350	380	1,065	2,650	3,100	2,350
2 hours	305	0	1,900	3	1	80
6 hours	350	1	1,350	1	0	0
24 hours	200	0	850	1	0	0

[1] Experiment conducted in 100 c.c. Jena glass flasks, each containing 15 mg. of the proper precipitate. All flasks inoculated with a 2 mm. loop of culture of *Bacillus coli* received from the Bureau of Animal Industry, isolated from hog. The temperature during this experiment varied from 18° to 22° C.

The presence or absence of carbon dioxid is probably important in this connection. If the laboratory results will hold for field conditions, a copper precipitate or a precipitate of iron and copper will be highly toxic to *Bacillus coli* and *Bacillus typhi* in a water whose alkalinity is chiefly monocarbonate; and, conversely, the action of a copper precipitate or a copper-iron precipitate will be reduced if a water contains free carbon dioxid. This is probably the reason that small quantities of copper are toxic[a] in a mechanical filter using the proper quantities of iron and copper, and gives an additional reason for the advice given by Ellms[b] and Brown[c] that before filtration or distribution of a copper-treated water all free carbon dioxid and part of the semicombined carbon dioxid should be neutralized by caustic lime. Copper treatment of water previous to slow sand filtration should be made under similar conditions, and as this is seldom practicable it is perhaps advisable to limit the use of copper in connection with slow sand filtration to treatment after passing the filter, and before distribution the proper quantity of caustic lime may be added. An excellent example of the results to be expected from incorrect use of copper in connection with slow sand filtration is furnished in Clark's[a] report. Not only was copper found in the effluent of the experimental filter, but *Bacillus coli* was found in a rather high per cent of the bacterial samples.

---

[a] Bul. 76, Bureau of Plant Industry, U. S. Dept. of Agriculture.

[b] Journal New England Water Works Association, vol. 19, 1905, pp. 496–503.

[c] Journal New England Water Works Association, vol. 19, 1905, p. 578.

The carbon dioxid content of the Ohio River is a possible explanation also of the fact reported by Brown[b] that samples of Ohio River water yielded between 0.00772 and 0.00657 grain of metallic copper to the gallon, tho *Bacillus coli* was occasionally present. To use his own words, "It is seen from the work done, as above stated, that the copper is present in an insoluble form and probably as the oxide united with the suspended mineral matter which the water carries. If in this form it would be unable to exert any germicidal power, and, as far as could be determined, this seems to be the case. It was decided that the copper was present in a spent condition." As there was no monocarbonate alkalinity noted, the Ohio River water at this time doubtless contained some free carbon dioxid, and from the analogy of the laboratory results it seems fair to assume that Brown's explanation must be supplemented by the theory of the heightened resistance of *Bacillus coli* due to carbon dioxid.

---

[a] Journal New England Water Works Association, vol. 19, 1905, pp. 503–505.

[b] The Purification of Water at Marietta, Ohio. Official Report to Board of Public Service, 1906.

O

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 100, PART VIII.

B. T. GALLOWAY, *Chief of Bureau.*

CONDITIONS AFFECTING LEGUME INOCULATION.

BY

KARL F. KELLERMAN,
Physiologist in Charge of Soil Bacteriology and
Water Purification Investigations,

AND

T. R. ROBINSON,
Assistant Physiologist.

Issued November 30, 1906.

2394148
13.1.30

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

CONTENTS.

	Page.
Introduction	5
Use of lime	6
Effect of soil conditions upon bacteria	8
Effect of heavy inoculation	11
Effect of aeration	13
Associative action of bacteria	14
Summary	15

ILLUSTRATIONS.

Page.

PLATE I. Pots of red clover, showing the effect of lime on a soil unfavorable to the growth of clover 8

II. Fig. 1.—Pots of garden peas, showing the effect of aeration on growth. Fig. 2.—The garden peas illustrated in figure 1, showing the effect of aeration on nodule formation 12

B. P. I.—233.

CONDITIONS AFFECTING LEGUME INOCULATION.[a]

INTRODUCTION.

The widespread use of bacteria for inoculating leguminous crops has made possible more accurate study of the conditions under which a particular species of legume might be successfully inoculated and the conditions under which failure to obtain inoculation might be expected. Inoculation tests carried on in different soils and under different cultural and climatic conditions but using the same stock culture have shown results so conflicting in certain cases that one is bound to be misled by any general statement based on one factor alone, such, for instance, as the condition of the bacteria used.

To accept as indicative of the general usefulness of pure cultures results obtained on a single type of soil is clearly opposed to progress along a line of investigation now recognized as closely connected with soil fertility problems. The advantage of numerous tests covering many types of soil becomes increasingly apparent. The effect of prevailing cultural practises is no less to be considered; aeration by cultivation, the use of lime, and the effect of such factors on the bacterial flora, the bacteriological testing of the soil itself—all these problems call for extensive field experiments to determine how far they may become part of practical routine for successful farming.

The work here recorded emphasizes the intimate connection of soil bacteriology with certain phases of soil fertility. Soil fertility is a strictly relative term; it is possible for a soil to be fertile in regard to one crop and unfertile in regard to another, the conditions of temperature and moisture being optimum in each case. The interaction between prevailing soil conditions and biological phenomena becomes apparent at once and lends confirmation to the belief that in practise œcological conditions may be so modified as to promote the activity of the desirable organisms and retard the development of the undesirable, altho under certain conditions the control of the bacterial flora undoubtedly will depend upon the introduction of virile cultures of desirable bacteria.[a]

---

[a] The identification of soil bacteria and their distribution in and correlation with different types of soil, the changes in the bacterial flora with different modes of treatment and different systems of rotation, the individual and combined action of the species in producing changes in the soil favorable or unfavorable to plant growth, the introduction of favorable species and groups of species and their improvement by selection or special cultivation, and the elimination of unfavorable forms are problems calling for extended investigation; but with the information already at hand and work under way both in this country and in Europe it is not too much to expect large increases in our present knowledge along these lines.—B. T. GALLOWAY, *Pathologist and Physiologist, and Chief of Bureau.*

USE OF LIME.

Samples of soil have been obtained from fields in various parts of the United States where attempts to inoculate legumes have failed, and greenhouse tests have been made combining various quantities of air-slaked lime with these soils. The effect of applying lime to certain types of soils is rather striking when nodule formation is considered.[b] This is especially true of those soils which give an acid reaction to litmus,[c] altho several of these unfavorable soils did not give an acid reaction to litmus, but were nevertheless benefited by lime. Outlines of a few typical cases selected from our experiments follow.

---

[a] The fact as shown in numerous cases that legumes can be successfully inoculated by the use of pure cultures of the nodule-forming organisms with a consequent large gain in yield and amount of nitrogen fixt is in conflict with the statement that "An enhancement of the desirable bacterial activities of the soil can only be encouraged by the proper improvement in the physical and chemical composition of the soil." (Lipman, "The Measure of Soil Fertility from the Nitrogen Standpoint," N. J. Agr. Expt. Sta. Rept., 1905, p. 243.)

[b] Fruwirth. Neue Impfversuche mit Lupinen. Deutsche Landw. Presse, vol. 18, 1892, pp. 18 and 127.

Fruwirth. Dreijährigen Impfversuche mit Lupinen. Deutsche Landw. Presse, vol. 19, 1893, p. 6.

Heinrich. Action de la chaux sur les lupins. Zweit. Ber. Landw. Versuchsst., 1894, p. 272.

Passerini. Sur l'influence améliorante des légumineuses dans des sols de compositions différentes. Staz. Sper. Agr. Ital, vol. 30, 1897, p. 68.

Deherain and Demoussy. Recherches sur la végétation des lupins; deuxieme partie, Lupins bleus. Ann. Agron., vol. 26, 1900, p. 169.

Deherain and Demoussy. Études sur les légumineuses de grande culture. Lupins jaunes. Ann. Agron., vol. 28, 1902, p. 449.

Bilwiller. Cited by Miller. Journal Roy. Agric. Soc. England, 1896, pp. 236 and 423.

Mazé. Les microbes des nodosités des légumineuses. Ann. Inst. Pasteur, vol. 13, 1899, p. 145.

Salfeld. Vernichtung der Leguminosenpilze durch Ætzkalk. Deutsche Landw. Presse, vol. 21, 1894, p. 785.

Tacke. Action de la chaux vive sur les bactéries des tubercules des légumineuses. Centralbl. f. Agriculturchemie, vol. 25, 1896, p. 297.

[c] G. A. Billings (N. J. Agr. Expt. Sta. Rept., 1905, p. 358) shows the efficient action of lime in promoting the growth of alfalfa and that the vigor of the plants seemed to be correlated with the form and greater abundance of root nodules. He suggests that soil acidity, conditions of ventilation or soil porosity, and different bacteria which may influence the form of the nodules are determining factors, controlled at least partially by the action of lime.

A quantity of soil was obtained from Blue Hill, Me., where the culture tried last year had shown no benefit with garden peas. One portion of this soil was placed in ordinary greenhouse pots; a second portion was thoroly mixt with pulverized lime at the rate of 1 ton to the acre, approximately, and placed in similar pots, and inoculated seed sown in half of each series. Of 15 plants unlimed, 10 were without nodules, 5 having a single nodule each; of 17 plants limed, 15 were well noduled and 2 apparently free, but nodules were evident on close examination. The uninoculated pots in the unlimed series had no nodules; in the limed series there were only a few scattering nodules, the majority of the plants, 10 out of 18, being free.

This experiment was repeated, the soil itself being inoculated with the liquid culture, with results even more striking. Of 17 plants unlimed, 12 were without nodules, 5 having a total of 8 nodules; of 16 plants limed, all were well noduled, having a total of 87 nodules. The uninoculated pots in the unlimed series had no nodules; in the limed series, 15 out of 17 plants had no nodules, the other two having a single nodule each.

The combination of liming and inoculation was again strikingly shown with alfalfa grown in a poor sandy soil from Lanham, Md. In this case it seems reasonable to assume that alfalfa bacteria of low virility were present in the soil. Under the normal unfavorable soil conditions the native bacteria were unable to produce inoculation and the virile ones from the pure culture, while able to inoculate the alfalfa plants, could benefit them only slightly. In the limed soil, however, the native bacteria were able to produce nodules in considerable numbers and to be of moderate benefit to the plants. The pure cultures of virile bacteria under similar conditions, however, caused more than double the increase that may be ascribed to the native bacteria.

The following table shows the relative virility of the two types of alfalfa bacteria in soil from Lanham:

Treatment.	Number of plants.	Number of nodules.	Average height.	Average dry weight.
			Inches.	*Grams.*
Lime:				
Inoculated	9	12	15.5	0.39
Uninoculated	13	15	13	.15
No lime:				
Inoculated	10	11	10	.09
Uninoculated	9	0	9	.06

Similar results were obtained with a large number of soils concerning which unfavorable reports had been received regarding attempts at inoculation with cultures furnished by the Department of Agriculture. Field observations on the nodule formation of various legumes showed the effectiveness of using lime or some other agent to counteract the influence of substances in the soil unfavorable to the growth of the bacteria.[a]

EFFECT OF SOIL CONDITIONS UPON BACTERIA.

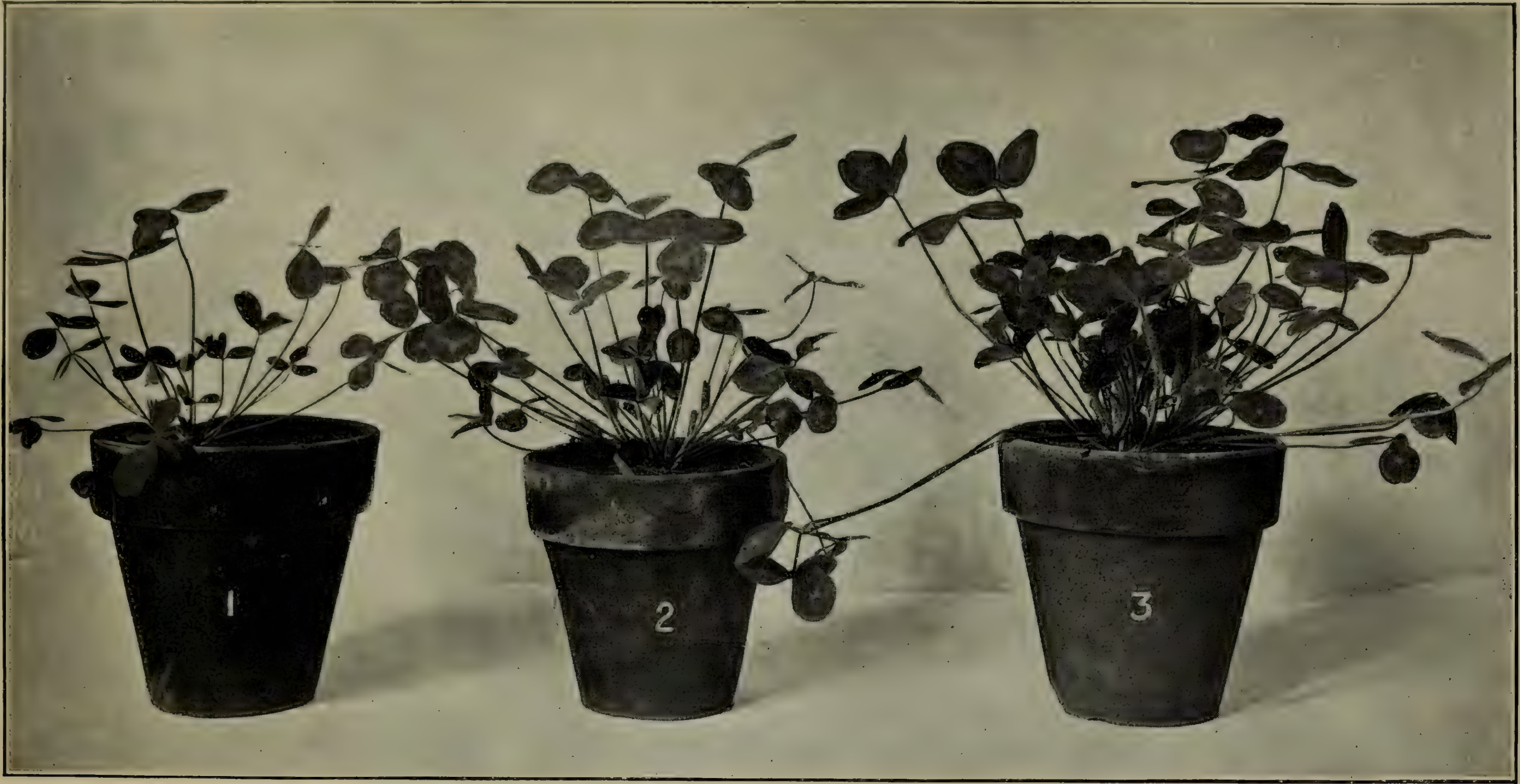
The constitution or character of the soil solution has great effect upon the growth of nodule bacteria as well as upon the formation of nodules. In the large number of soil samples tested simultaneously in the greenhouse and in the laboratory it seems to hold true generally that the possibility or impossibility of securing effective inoculation on a particular crop in a certain soil can be predicted by the relative growth of the specific culture in the sterile extract of the soil in question. There also seems to be a somewhat close relation between the soil solution necessary for the growth of host and bacteria, so that in many cases, at least, it is possible to determine the suitability of a legume crop to a certain soil by the growth of the specific culture of *Pseudomonas radicicola* in the extract of the soil. The probability of an extract not truly representing the soil solution and the disturbing factor of sterilizing certain extracts will in some cases introduce error in interpreting results. The use of sterilized soil extracts as culture media for the bacteria has been found to give fairly true indications of the growth of the respective hosts of these bacteria in a considerable series already tested, however, and contemplated improvements in technique will doubtless increase the probability of securing trustworthy indications. The testing of the soil extract in its behavior toward specific bacteria may even indicate that some treatment is necessary, but can not prescribe the method of amelioration, and for the present direct experimentation is necessary to determine the proper treatment of an unsuitable soil.

As an example of the relation between the growth of the specific bacteria in the sterile soil extract and the growth of the legume host in this soil may be cited the following result of a fairly representative test, using different quantities of lime on an unfavorable soil which responded favorably to treatment with lime:

Quantity of lime.	Green weight of plant.	Number of nodules.	Number of bacteria in a cubic centimeter of soil extract.
	Grams.		
Unlimed	2.5	31	87
Limed:			
2,000 pounds to the acre	5.5	63	71,950
4,000 pounds to the acre	8.5	88	128,650

---

[a] For the presence of substances in poor soils deleterious to higher plants, see Bureau of Soils Bul. No. 28, 1905, "Studies on the Properties of an Unproductive Soil."



POTS OF RED CLOVER, SHOWING THE EFFECT OF LIME ON A SOIL UNFAVORABLE TO THE GROWTH OF CLOVER.

1.—Unlimed. 2.—Limed at the rate of 2,000 pounds to the acre. 3.—Limed at the rate of 4,000 pounds to the acre.

The accompanying illustration (Pl. I) shows characteristic pots of red clover from a series of soils from South Salem, N. Y., where clover had been steadily diminishing in vigor for years. The nodules on the unlimed plants were small and clustered around the crown of the plant, while the limed plants showed numerous nodules well distributed. The stand secured in a series of limed pots was four times as heavy as without the use of lime.

In comparison with this unfavorable soil, the extract obtained from soil sent in from a favorable field test at Carlisle, Pa., gave an excellent growth of the red clover bacteria, and the inoculated red clover grown in this soil in pots showed numerous nodules and a better growth than in the uninoculated pots, thus confirming results obtained in the field.

It may be noted that there is a difference exhibited among different legumes in their behavior toward lime. While for most legumes its effect is beneficial, a few species, such as lupine and serradella, are actually injured by its use[a] and some other legumes, such as Lima bean and cowpea, do not respond to lime even in soils where clover refuses to grow without lime. It has been noted[b] that serradella is not successful when following red clover, and that results are also unsatisfactory when red clover follows serradella. These varying relations shown by legumes belonging to different groups in their relation to lime and other conditions emphasize the necessity of determining as accurately as possible the adaptability of different soils to the crops for which they are intended.

Observations upon the occurrence of nodules in certain soils have been found to correspond quite closely with the behavior of the soil solution toward the bacteria of the legumes tested. The preceding table illustrates this point, tho perhaps not so clearly as the following examples.

In the case of a fairly rich garden soil, soy beans would not form nodules even after very heavy inoculation, and the extract from this soil used as a culture medium was found to inhibit the growth of the soy bean bacteria. On the other hand, alfalfa readily formed nodules in this soil and the soil extract was not unfavorable to the growth of the alfalfa bacteria.

A soil from Niles, Mich., which had grown a fair crop of soy beans for four years without the occurrence of nodules, was tested. The soil extract in this case was found unfavorable to the growth of the soy bacteria. In greenhouse pot tests soy beans of several varieties failed to produce any nodules in this soil even when heavily inoculated with cultures which produced abundant nodules in other soils tested in comparison. Heavy liming of the soil extract at the rate of about 6,000 pounds to the acre gave a fair growth of the bacteria, and corresponding to this result one pot that received lime in the same proportion produced a well-noduled plant. In this same soil without lime and without inoculation cowpeas formed nodules abundantly.

---

[a] See Rhode Island Agr. Exp. Sta. Rept., 1896, p. 256; also Bul. 96, of same station, 1903.

[b] Deutsche Landw. Presse, vol. 32, 1905, p. 799.

A soil from Lanham, Md., gave an extract which as a culture medium was distinctly unfavorable to the growth of red clover bacteria, and plants of red clover in this soil made a very sickly growth, producing few nodules. A few pots were boiled by immersing in a tub of water and blowing live steam into the water; the soil was of a sandy character, so that there was little danger of puddling from this treatment. The growth of red clover was markedly improved in the boiled series and the roots were well noduled after inoculation. The extract of this soil, sterilized by boiling, had proved an unfavorable medium for the growth of the bacteria. It is probable, therefore, that boiling the soil changed the character of the soil solution at least in regard to the unfavorable materials or conditions which had inhibited bacterial activity.

Soil from Lanham, Md., was further tested with alfalfa, treating the soil in three ways: (1) Lime at the rate of one ton to the acre; (2) lime and one-fourth humus, composed of leaf mold; (3) humus. The combination of lime and humus gave the greatest growth and most abundant nodule formation. With humus alone the growth was especially inferior and nodules were lacking even where the soil was inoculated. Inoculation doubled the number of nodules where lime was used and increased them six times where both lime and humus were used.

Effect of humus and lime upon the growth of alfalfa in soil from Lanham, Md.

[Ten plants in each series.]

Treatment.	Average (green) weight of plant.	Average number of nodules.
Lime alone:	*Grams.*	
Uninoculated	0.86	0.5
Inoculated	1.56	1.0
Humus alone:		
Uninoculated	.5	0
Inoculated	.8	0
Humus and lime:		
Uninoculated	.73	1.4
Inoculated	2.45	8.6
No lime; no humus:		
Uninoculated	(*)	.3
Inoculated	(*)	.5

*Not weighed; growth so small as to be a practical failure—2 to 5 inches as compared with 12 to 18 inches high in the limed pots or those containing lime and humus.

The sterilized extracts of soil from this series of pot tests gave results seemingly contradictory when used as culture media for bacteria in comparison with the growth of plants and nodules. The extract of untreated soil gave a growth of the alfalfa bacteria which might be designated "fair," while with lime, with lime and humus, and with humus alone the extracts gave uniformly a growth which might be designated "excellent." In the pots, however, no nodules developed in the humus series. The sterilization by heat of the extract from a soil containing such a relatively large quantity of humus, one-fourth by volume, probably changes the material so that the solution becomes favorable to the growth of the bacteria, but this material in the soil pots, not heated, remains unchanged and may in this form be unfavorable to the activity of the bacteria introduced into the soil.

Aside from the effect of the soil on nodule formation there seems to exist a marked difference among different varieties of legumes in their susceptibility to infection—that is, their readiness to form nodules. With a similar soil and one which is favorable to the growth of the respective species, nodules will occur in abundance upon one species or variety and another species or variety will exhibit none or only a few. This is particularly noticed with varieties of soy beans and with certain species of Phaseolus, the Lima bean (*Phaseolus lunatus*) and some varieties of soy beans being very difficult to inoculate. It would seem that such species were actually resistant to infection, especially in soils rich in nitrogenous matter.

EFFECT OF HEAVY INOCULATION.

The decided advantage of very heavy applications of pure cultures reported from some field and pot experiments and reports of other experiments showing that cultures diluted to almost infinitesimal limits gave as good results as undiluted cultures seem at first diametrically opposed. Greenhouse tests seem to confirm the beneficial effect to be expected from heavy inoculation provided excessive quantities of culture are applied. The following experiment is fairly representative:

Effect of light and heavy inoculation of garden peas on soil from Blue Hill, Me.

Treatment.	Number of plants grown.	Number of plants with nodules.	Average number of nodules.
Check, without inoculation	11	2	1
Light inoculation	9	6	3
Heavy inoculation	6	6	7

It is here shown that heavy inoculation not only doubled the average number of nodules upon inoculated plants, but insured all plants becoming infected; while with light inoculation in this unfavorable soil one-third of the plants failed to produce nodules, and with no inoculation nodules were almost entirely lacking.

Garden peas in a garden soil naturally inoculated showed the following difference where a heavy inoculation was made:

Effect of heavy inoculation of garden peas on a naturally inoculated garden soil.

Treatment.	Number of plants grown.	Number of plants with nodules.	Average number of nodules.
Untreated	15	15	6½
Heavy inoculation	18	18	19

It is highly probable that the cause of the formation of more numerous nodules in some cases is due not to the great numbers of bacteria which are introduced into the soil but to the quantity of culture medium introduced, which renders the soil solution a materially richer food for the active growth of the nodule organisms. Thus, if a few bacteria are brought into a favorable soil they will multiply rapidly, and it is of no particular moment in such a case whether a very few or a large number of bacteria are originally introduced. If, however, enough culture is added so that the soil solution is appreciably improved in food material for both plant and bacteria, then growth will be much more active and nodule formation will be greater. On this hypothesis the two results are not at all at variance, the effects produced depending on the soil conditions encountered by the bacteria and the crop.

The suggestion in a former bulletin[a] that the slight varietal characteristics exhibited by legume bacteria can be readily broken down by cultivation on synthetic nitrogen-poor media seems to hold only for bacteria isolated from plants physiologically related to the subsequent hosts.[b]

A typical experiment is given below:

Number of nodules produced on two varieties of mung bean (Phaseolus viridissimus and P. calcaratus) by cultures from various hosts.

[Ten plants in each of seven series.]

Variety of mung bean.	Bacteria from cowpea.	Bacteria from soy bean.	Bacteria from P. viridissimus.	Without bacteria.
Phaseolus viridissimus	*1	0	77	0
Phaseolus calcaratus	0	0	88	0

*Fifteen plants in this series.

It may be added that the soil used was unsterilized garden soil, naturally inoculated for our common bean, *Phaseolus vulgaris*, so that the uninoculated check may be said to serve as a cross-inoculation with these organisms also. This theory of varietal differences of nodule-

---

[a] Bul. 71, Bureau of Plant Industry, 1905, pp. 25–27.

[b] See Schneider, Ill. Agr. Exp. Sta. Bul. 29, 1894, p. 301.

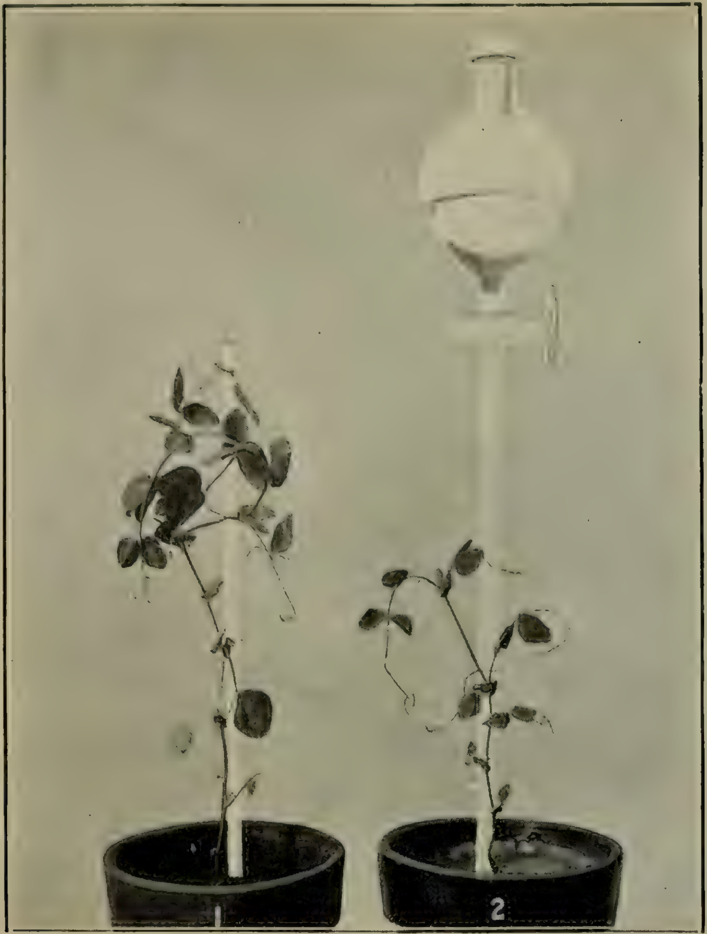


FIG. 1.—POTS OF GARDEN PEAS, SHOWING THE EFFECT OF AERATION ON GROWTH.

1.—Ordinary unglazed pot; surface of soil frequently stirred. 2.—Glazed pot; surface of soil paraffined and water introduced thru separatory funnel.

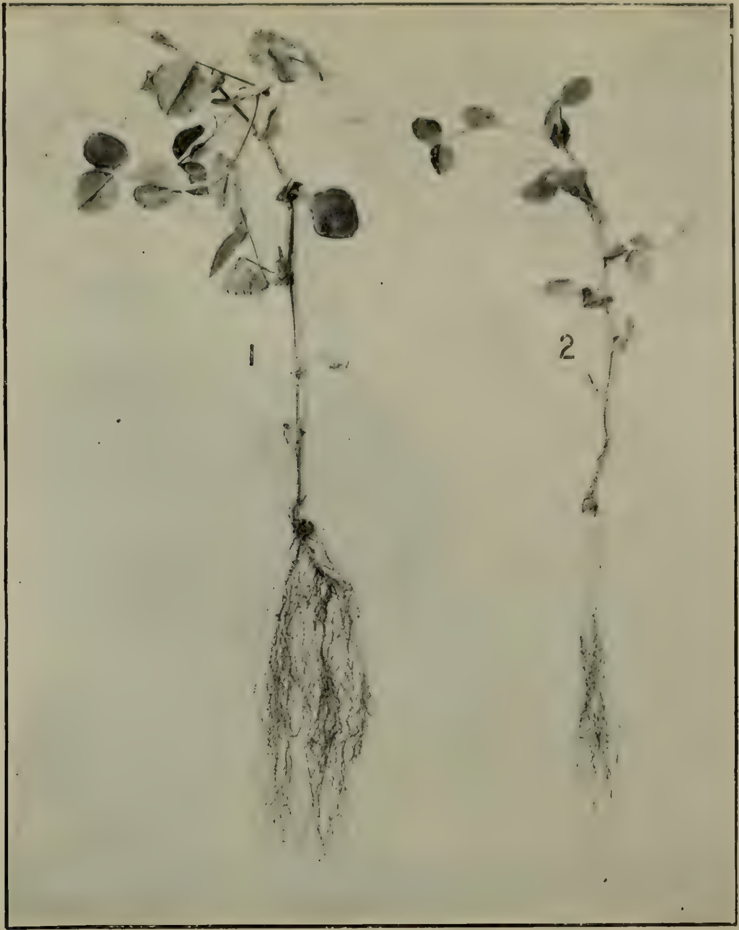


FIG. 2.—THE GARDEN PEAS ILLUSTRATED IN FIGURE 1, SHOWING THE EFFECT OF AERATION ON NODULE FORMATION.

1.—Plant from unglazed, aerated pot. 2.—Plant from glazed pot from which air was partially excluded.

forming bacteria is closely in accord with field results reported by various investigators, among whom perhaps Hopkins[a] is best known for his observations upon the cross-infection between sweet clover and alfalfa and the absence of such cross-infection between many other legumes.

EFFECT OF AERATION.

The aeration of soil for securing plentiful nodule formation is an important if not a determining factor. The Ontario Agricultural Experiment Station (Report for 1905, p. 39) reports a decided gain from aeration in the case of a leguminous crop (peas) and no gain from the aeration of a wheat crop. In the former case the result may be either a direct one, affecting the activity of the nodule bacteria, or it may be that because of the abnormal growth of the host plant the bacteria are unable to penetrate the root.[b]

Our own experiments upon the effect of aeration are in accord with those quoted in regard to the legumes, and the following is typical: A light sandy soil, moderately limed, was used and the legume selected was garden pea. The aerated series was started in ordinary unglazed 4-inch pots, seedlings dipt in liquid culture when placed in position, pots watered with a fine sprayer, using tap water. The surface of the soil was frequently stirred. The nonaerated series was made up of an equal number (6) of glazed 4-inch pots with bottoms plugged with paraffined cotton and the top covered with paraffined paper to reduce aeration. A separatory funnel (shown in Pl. II, fig. 1) was thrust into each of these pots to admit water for growing the peas, and after inoculating as with the other series the seedlings were introduced thru a hole in the paraffined paper. After a month's time the roots of the plants were examined, with the following results:

---

[a] Ill. Agr. Exp. Sta. Bul. 94, 1904, Nitrogen Bacteria and Legumes.

[b] Livingston (Bot. Gaz., XLI, 2, 1906, p. 143; see also Bureau of Soils Bul. No. 28) reports a close relation between the growth of roots and tops in wheat, due to a difference of soil, which he explains as follows: "It would seem that the poor soil by inhibiting branch growth and causing the enlargement of cortical cells may render the root system unable to carry on an adequate amount of absorption for normal growth." If this effect upon the cortical cells should be found to hold true with the legumes, it might have a direct bearing upon the ability of the bacteria to penetrate and form nodules. The enlargement of the cortical cell is regarded as a phenomenon of age, and it is reported (Maria Dawson, Phil. Trans. Roy. Soc. London, Ser. B, vol. 192 (1899), p. 24) that infection takes place most readily in quite young radicals.

Aside from the effect of root development upon nodule formation, there is a possible interaction resulting in some way in greater root development where inoculation takes place. In many cases which have come to notice where inoculated plants had shown a superior development of the root system, it seemed at least justifiable to regard the inoculation as assisting in providing the conditions favoring a healthy root growth. In Bulletin No. 237 of the Cornell Agricultural Experiment Station, page 165, it is noted that where no nodules occur the roots of alfalfa are simpler and not so ramifying as where nodules occur.

Treatment.	Nodules on plant No.—						Total.
	1.	2.	3.	4.	5.	6.	
Aerated	4	20	25	8	26	4	87
Nonaerated	0	1	2	0	0	0	3

See Plate II, figure 2, noting the difference in the plants in favor of the noduled (aerated) plant.

ASSOCIATIVE ACTION OF BACTERIA.

Undoubtedly the pure cultures of nodule-forming bacteria are subject to contamination when planters, using convenient rather than bacteriological methods, prepare quantities sufficient to inoculate their seed. Yet the purity of a culture immediately before it is applied to seed or introduced into the soil of a cultivated field is unimportant, provided there is present a sufficient number of virile nodule-forming bacteria.

Preliminary experiments at Washington some years ago indicated that in the nitrogen-poor solution generally used the nodule-forming bacteria would develop much more rapidly than other bacteria or contaminating yeasts and molds. It might be expected that different localities would have different contaminating forms, and during the past year samples of cultures have been obtained from farmers in various parts of the United States immediately before the seed or soil was treated. Investigation of contaminating forms isolated from these cultures shows that there are certain forms which inhibit the growth of the nodule organism when both are grown for some time in the usual nitrogen-poor solution.[a] Using an extract of a favorable soil as a culture medium, results very nearly parallel for the competing bacteria were secured, tho one organism which resembles *Bacillus coli* checked the growth of *Pseudomonas radicicola* in the synthetic medium and not in the soil extract. The relative virility of the competing cultures at the time they begin their struggle is an exceedingly important factor in determining which species of bacteria survives.

Extended experiments on the interaction of groups of bacteria in various media must be carried on before it will be possible to determine all of the conditions incident to success or failure in legume inoculation.[a] It is safe to assume, however, that the action of a bacterium in the soil is conditioned not only by the chemical and physical characteristics of the soil solution at a particular time, but also, and perhaps essentially, by the biologic conditions obtaining in that soil.

---

[a] In view of this fact, the reason for our present method of distribution is apparent. A relatively large amount of pure liquid culture used as a "starter" cuts down the chances of ruining the farmer's culture thru the competition of contaminating forms; the time required to fill the solution with the organisms is shortened, and, as shown subsequently, the quicker the bacteria can be introduced into the soil and make use of the soil solution as a culture medium the less becomes the danger from competition.

SUMMARY.

1. Lime is of decided benefit in obtaining successful inoculations of legumes in some soils. These soils often show an acid reaction to litmus.

2. Soil extracts serving as culture media often indicate the probable success of inoculating a leguminous crop. This, however, may not always hold true.

3. At least during the first season's growth no general cross-inoculation takes place. Bacteria from one host may, however, inoculate a physiologically related species.

4. Heavy inoculation by a pure culture increases nodule formation if the soil solution is enriched by the excess of culture medium; however, in a favorable soil a light inoculation well distributed is as effective.

5. Thoro aeration is favorable to nodule formation.

6. Whether in a synthetic medium or a natural soil solution, the functions of a bacterium are influenced by the associative or competitive action of the various groups of organisms with which it comes in contact, as well as by the nature of the culture material.

---

[a] See Maria Dawson, Phil. Trans. Roy. Soc. London, Ser. B, vol. 193 (1900), p. 65.

O

BINDING LIST MAR 1 1930

SB 19 A35 no. 91-100
U.S. Bureau of Plant Industry, Soils, and Agricultural Engineering
Bulletin

PLEASE DO NOT REMOVE
SLIPS FROM THIS POCKET

Biological
& Medical
Serials

UNIVERSITY OF TORONTO
LIBRARY